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Errata

Page 69, line 14 from bottom, for Antiles read Antilles.

Page 75, line 3 from bottom, for advanced read advancing.

Page 83, line 9 from top, for *Spatina* read *Spartina*.

Page 445, line 13 from top, for views read veins.

Pages 441, 442 and 444, for *Dictyocephalos* read *Dictyocephalus*.

Page 454, line 2, omit and.

Page 456, line 22, for shale read Shale.

Page 456, lines 24, 25 and 27, for coal measures read Coal Measures.

Page 456, line 30, for carboniferous read Carboniferous.

Page 460, line 21, for One read On.

Page 468, line 34, omit the.

Page 481, line 10, omit the first in.

Page 498, line 5, for nat. size read ½ nat. size.

Page 536, after *Thrinax Ponceana*, for 43 read 45.

Page 548, after *Aeria attenuata*, for 45 read 47, fig. 1.

Page 552, after *Roystonea Borinquena*, for 45 read 47.

Page 557, after *Acrista monticola*, for 44 read 46.

Page 561, after *Curima colophylla*, for 46 read 48.

Plate 30, for *Vincetoscicum* read *Vincetoxicum*.

Plates 39, 40, for *Dictyocephalos* read *Dictyocephalus*.

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TORREY BOTANICAL CLUB

JANUARY 1901

Life History of Schizaea pusilla

BY ELIZABETH G. BRITTON AND ALEXANDRINA TAYLOR

(WITH PLATES 1–6)

The material on which these studies were based was collected at Forked River, New Jersey, on the third of July, 1900. The plants were abundant, but only half grown, the sporophylls being only five centimeters high. They were found around the base of small white cedars (*Chamaecyparis thyoides*) kept moist by hummocks of *Sphagnum*, and surrounded by *Lycopodium Carolinianum*, *Juncus pelocarpus*, *Drosera rotundifolia* and *Utricularia cleistogama*. Young plants were found, ranging from two to ten millimeters in height, growing in depressions of moist sandy loam, or even perched upon the roots of sedges and *Sisyrinchium Atlanticum*. Several sods were taken with the plants in various stages, and a large number of young plants were collected and preserved in alcohol. With a magnification of fifteen diameters, it was discovered at the time of collection that they originated from a filamentous protonema, consisting of a tangled mass of dark green filaments, spreading around the base of the young circinate leaf, and that these filaments were persistent, even after some of the leaves were 10–15 mm. high. Entangled with the filaments, in such a manner as to render it necessary to clean them with a camel's-hair brush, there were three species of hepatics (*Odontoschisma sphagni* (Dicks.) Dumort; *Lophozia inflata* (Huds.) M. A. Howe; and *Cephalozia catenulata* (Hübn.) Spruce; also a slender fresh-water alga, *Rhizoclonium hieroglyphicum* (Ag.) Kütz.

[Issued 31 January.]

A complete or correct description of *S. pusilla* cannot be found in any manual or monograph. In several the spores are said to be smooth, and the glandular hairs borne by the leaves are not mentioned, though they are known on other species of this genus.

The gametophyte is composed of numerous, erect, branching, dark green protonemal filaments; monoicous, bearing from 5–12 archegonia, usually on a slightly thickened and expanded series of cells in the nature of an archegoniophore (?) or directly on the filaments; antheridia more numerous, often on separate branches and nearer the extremities of the filaments; radicles seldom borne on the filament but produced from specially modified, large spherical cells, apparently in symbiotic relation with a fungus. Sporophyte perennial, from a short erect or horizontal rootstock, 5–10 mm. long, sterile leaf 2–5 cm. long by 0.5 mm. broad, circinate, bearing small club-shaped hairs, nearly 1 mm. long, occurring in three longitudinal rows on the dorsal surface, alternating with two rows of stomata. Sporophyll 3–13 cm. long, divided at summit into 14–16 fertile pinnae; sporangia ovoid, with a terminal ring: spores reniform, pitted, 76–84 μ, maturing in autumn.

On low wet banks with sphagna or in sandy swamps, in the shade of larger plants; known from numerous scattered stations in the Pine Barrens of New Jersey, in Newfoundland (De La Pylaie, Waghorne), and in Nova Scotia (E. G. Knight). The station credited to New York by Prantl from the Berlin Herbarium, is probably a mistake, though there is no reason why it should not be found on the sandy plains of Long Island and Rhode Island.

According to Prantl there are nineteen species of *Schizaea*, of which five are Polynesian, eight are found in Brazil, and five in the West Indies; all are of restricted distribution, and in most species they are known from few stations. Of *Lygodium* he records twenty-two species, of which five are Mexican and Central American, four West Indian and only one from northeastern North America, *L. palmatum*. Of the forty-six species of *Ornithopteris* and *Anemia* known, Brazil has thirty-five, Mexico nine, the West Indies six and only two extend into the United States, *O. adiantifolia* (L.) Bernh., and *O. Mexicana* (Kl.) Underw.

The Schizaeaceae are represented in the Tertiary by several

species of *Lygodium*, and by *Anemia* in the Cretaceous. Thus far *Schizaea* is unknown in the fossil state. We may safely conclude, however, that its maximum development in North America must have been reached previous to the Glacial period, and that it is in a degenerate condition and retrograding distribution in the only surviving species, *Schizaea pusilla*, whose larger and more highly developed relatives exist now only in the tropics.

SPORES

The spores of *Schizaea pusilla* measure 76–84 μ, are nearly reniform (Fig. 1), and have a cuticularized exospore which is alveolate (Figs. 2, 3); on the concave side there is a ridge extending nearly two thirds the length of the spore, formed by the exospore having a fissure nearly its whole length (Fig. 4). It is through this slit in the exospore that the young tube emerges when the spore germinates.

The development of the gametophyte from the spore to the first archegonium could not be followed in the laboratory; but from the laboratory cultures and the different stages of spore germination found in the soil brought up from New Jersey a fairly good idea of the manner and rate of growth may be drawn.

Spores, from the plants collected in July and matured in the greenhouse, were sown on September 5th; on the 14th they were found to be slightly green; the first signs of germination were seen on the 27th, when the spores contained some chlorophyl, and two had started to send out a tube which extended 27 μ beyond the aperture (Fig. 5); chlorophyl was visible in the lengthening tube on the 8th and rhizoids were also found on that date; the first cross-wall was formed on the 10th; on October 1st the second wall was formed making a filament of two cells (Figs. 9, 10).

On August 28th a spore was found in the sod of young plants which had germinated and formed a small rhizoid, slightly brown, with a curved apex and contained some chlorophyl, and a filament, 115 μ in length, of two cells (Fig. 19), the cell at base was shorter, about twice as long as broad, containing chlorophyl with no special arrangement; the other cell was nearly four times as long as broad, the chlorophyl denser at the apex and a newly formed wall (Fig. 19, *a*). The density of the chlorophyl increased at the

apex. On August 30th the chlorophyl showed a tendency to assume its final arrangement in the filament, being very dense in the center, radiating toward the walls in rather thick bands and connecting with a layer next to the wall through the whole length of the cell; on August 31st the filament had lengthened to 126 μ and one more cell had been cut off (Fig. 21), no further change in the rhizoid having taken place. The filament consisted of five cells by September 2d. On September 4th the filament had increased to six cells, and a partial division of the contents of the apical cell had taken place (Fig. 22). The tip of the filament was very much curved and densely packed with chlorophyl; the basal cell of the filament had become slightly swollen near its apical end. The filament measured 146 μ.

On September 5th the filament consisted of six cells (Fig. 23); the first walls formed were very nearly as thick as the cross-walls of the older filaments.

The older filaments generally grow erect, and this tendency toward an upward growth is plainly shown even as early as the third cell of the filament; the rhizoid also showed geotropic curvature. One tube, issuing from the fissure of an exospore, was directed downward; but soon began a curvature which was continued until the filament occupied a vertical position; the rhizoid, first directed horizontally, soon curved downward. The filaments, for the most part, did not show the tendency to upward growth until two or three cells had been formed, but the rhizoid took a downward direction much earlier.

On September 5th another spore was found in the soil consisting of one filament of six cells (Fig. 24); at the base of the filament, at its connection with the spore, there was a cell which had evidently been the basal cell of another filament. The remaining filament had given rise to two antheridia, which though not dried up were empty; one antheridium arose from a short branch from the second cell, occupying the terminal cell of the branch; the other originated from the terminal cell of the filament.

A spore with a healthy filament of four cells (Fig. 26) had borne an antheridium in which the mother cells of the antherozoids could be easily seen.

The attachment of the spore appears to be of long duration, as antheridia are formed while the filament is still attached.

A sporangium (Fig. 27) filled with spores was sown at the same time with the free spores on September 5th, and a great number of the spores germinated inside the sporangium sending out filaments through a basal break; when the spores were removed from the sporangium they were found to be more advanced than those germinating outside, the rate of growth of the spores in the sporangium in a given time being almost twice that of the other spores.

Branches were given off from the basal cells of the filaments, sometimes from apical portions of young filaments, and in a few cases the spore cell was found to divide into three primary cells (Fig. 17).

Intermediate stages between the earliest developed filament from the spore and the much-branched protonema are lacking.

PROTONEMA

The protonema occurs on the substratum, or on rootstocks of other plants, as small tufts of a dark green color, growing to a height of 2 mm. and a breadth of 4 mm.

The protonemal filaments are larger than the protonema of mosses. A comparison was made with *Pogonatum brevicaule* and *Mnium punctatum* with the following results:

	Length	Breadth
Cells of *Pogonatum brevicaule*	46 μ 76.9 μ	7 μ
Cells of *Mnium punctatum*	115 μ 96 μ	15 μ 23 μ
Cells of *Schizaea pusilla*	192 μ 173 μ 134 μ	92 μ 38 μ

It is also seen from the above that the cells of the filaments of *Schizaea pusilla* are fairly uniform in dimensions. They are densely filled with chlorophyl; starch is present. The cells are cylindrical, sometimes flattened near the base, in the region of the archegonia. Some few of the cross-walls were found to be perforated.

The protonema is copiously branched, the branches being generally single from each of the cells of the filament, generally near the upper end of the cell (Figs. 72, 73). Occasionally three or four in succession will give rise to two branches from opposite

sides, but maintain the same relative position (Fig. 30). The branches, which give rise to the spherical cells to be described below, divide in the same manner as the main filaments. The division of other branches is very irregular (Figs. 29, 30, 31). The rhizoids are not usually formed directly from the ordinary cells, but from specially modified cells (Fig. 38, *a*); in three instances only were rhizoids found directly on the filaments, and in one case one cell gave rise to two rhizoids. They arise as lateral branches, at right angles to the long axis of the filament and taking the place of branches (Figs. 38, 39). There were two cases found (Figs. 32, 33) where the cells of a branch, near the apex, had formed partition walls. In Fig. 32 the third cell from the apex had divided up into four cells, showing a tendency to form a flat prothallus. Three cells showed signs of division (Fig. 33): these two instances were the only ones found. Bower speaks of flattened expansions on the filamentous protonema of *Trichomanes alatum* and *Trichomanes sinuosum* as described by Mettenius. These are much more rudimentary in *Schizaea pusilla.*

Some cells of the filament have been found to undergo division in the later stages, into a number of disk-shaped cells which do not increase in the axial diameter. Constrictions sometimes follow such divisions at the older cross walls; the cell walls were a light brown and showed signs of decay. Fig. 35 shows the cells of the filament undergoing the same process, but these were as healthy as the rest of the filament and densely filled with chlorophyl. Bower refers (Ann. Bot. 1: *pl. 1. f. 8*) to a similar development in *Trichomanes pyxidiferum* and says that "* * * possibly the moniliform development is merely a pathological condition; its appearance, however, is suggestive of that segmentation of the protonema into spherical cells which is recorded as a mode of vegetative propagation for the protonema of *Funaria hygrometrica.*"

After some of the filaments have formed several cells the apical cell cuts off a new cell, which, after the first partition wall, that is transverse septum, divides longitudinally, forming two cells (Figs. 36, 37). These cells become large and round, each cell containing chlorophyl, and giving rise to one, or generally two, rhizoids (Fig. 37, *a*). The rhizoids also contain chlorophyl and early take on a dark yellow color. The original cell of the fila-

ment from which these cells arise either continues its growth normally (Fig. 36), or by a lateral innovation (Fig. 37). This new filament, after the formation of two or three cells, may form spherical cells at its apex (Fig. 39), or continue for some time before doing so, or it may send off a branch at once, which in its turn forms spherical cells. Generally a filament forming the spherical cells once does so at intervals throughout its whole length (Figs. 72, 73). These branches early bend to the substratum. If examined at this stage they will be found to have lost their former contents and to be filled with fungal hyphae (Fig. 43). This fungus does not injure its host, but sets up a symbiotic connection by which it functions as an absorbing organ to supply the gametophyte. So the spherical cells are undoubtedly formed by the gametophyte for the reception of the fungus, which enters as soon as the rhizoids touch the substratum (Fig. 41). While above ground and filled with chlorophyl they do not show any evidence of the presence of a fungus. The rhizoids wither early and absorption is carried on almost entirely by the fungal hyphae. The lack of rhizoids on the filament is thus explained by the presence of this fungus symbiont. The rhizoids formed from these spherical bodies appear to be the only channels through which the fungus enters the chambers built for it.

As to the nature of the fungus it is at present impossible to give it a permanent place in any of the series because of lack of evidence in regard to its method of reproduction. Perithecia have been found with asci and also what was probably a conidial stage; fruit bodies of other forms have also been found among the filaments; however, none of these were connected with the fungal hyphae under discussion. The young filament shortly after germination was in some few cases attacked by a fungus (Fig. 17, *d*), and this fungus is found wrapped around many of the cells of the older filaments, several instances having been found where haustoria had penetrated into the cells. Some of the plants are so infected by fungi after the growth of the sporophyte has begun that all the filaments have thickened walls and are pierced by three or four haustoria in each cell; they have turned brown and lost their contents. This fungus not only clings to the gametophyte of *Schizaea pusilla* but attacks the sporophyte also, though it does

not appear on the sporophyte until the first leaf has reached a height of 1 mm. It resembles the one referred to by Bower in his work on *Trichomanes*. No connection has yet been made between these hyphae and those of the fungus symbiont. As far as is known at present, the fungus which wraps itself around the protonemal filaments is the same or at least bears a very close resemblance to that which attacks the sporophyte both on the rhizome and leaf.

The hyphae of the symbiotic fungus penetrates the rhizoid generally a short distance back from the tip (Fig. 41, *c*). These hyphae sometimes branch in the rhizoid and their cross-walls are more numerous, and in many cases the hyphal threads appeared narrower. They enter the large spherical cells where they form bladders or granulated swellings in these cells, sometimes nearly filling them (Figs. 42, 43). The fungus sometimes penetrates the ordinary cells of the filament, entirely changing the shape of these cells. Pale brown bodies were found of irregular outline attached to the hyphae which were apparently sporangia.

ANTHERIDIA

The antheridia are produced laterally on the protonema, occupying the terminal cell of the lateral branch or more rarely the terminal cell of a filament, which continues its growth laterally or ends with the formation of the antheridium. They are found either singly or in groups; and may be considered as metamorphosed branches as in Fig. 44. They may either be formed from the terminal cell of a short lateral branch (Fig. 44) or from the terminal cell of a branch given off from the basal cell (Figs. 44, 48) or from the second or any other cell of a lateral branch (Fig. 44) or rarely they may be formed on the terminal cell of a short lateral branch given off from the same cell of the filament as a previous antheridial branch (Fig. 46). Occasionally these groups are borne on a branch of the filament which bears only antheridia (Fig. 48) and for the most part in groups, sometimes from both sides of a branch. These branches which bear the antheridia, whether it is a branch of two cells with the apical one becoming an antheridium, or one of the groups, occupies the same relative position on the filament as do the branches of the main filament.

One or two were found to start out from the center of a cell of a filament. The antheridia are produced in great quantities but a great number of them are aborted, and the majority of antheridia terminate a branch of two cells. They occur nearer the apex of the filaments than the archegonia, and sometimes on the same filament with the archegonia (Fig. 57). They also occur on a branch from the filament which gives rise to the archegonia; when they are borne on a separate filament they are generally formed in larger quantities. The cells of a filament which give rise to the antheridial clusters are often broader and sometimes shorter than the ordinary cells.

The antheridium is formed by a cell of a filament sending out a cell which divides by a partition wall near the apex (Figs. 49, 50). This apical cell enlarges and soon cuts off another cell by a wall parallel with the first (Fig. 51). This small cell does not elongate but always remains short and forms the pedestal for the antheridium; the apical cell becomes large and globular and cuts off a cap cell at the summit, with the wall oblique (Fig. 52); the large cell divides up into the mother cells of the antherozoids (Figs. 52, 53, 54) and one ring cell. In some cases there appear to be a single layer of two or three peripheral cells. The ring cell (or cells) contain chlorophyl though they lose this before the antherozoids are matured. Dehiscence takes place by the swelling of the ring cell and the rupture of the cap cell. The antherozoids appear to be surrounded by a very fine membrane when they escape from the antheridium (Fig. 55); they are spirally coiled, with cilia at their anterior ends. Very few ripe antheridia were found. The antherozoids do not seem to be produced in large quantities.

ARCHEGONIA

The archegonia occur nearer the base of the filaments than the antheridia (Fig. 57) on cells of the filaments which have become more than one cell wide through division. They generally bear the same relation to the original cell of the filament as do the branches from other cells; they are borne singly or in pairs (Fig. 63), sometimes in groups of three or four (Fig. 58) often on both sides of the protonema. One filament was found which gave rise on six consecutive cells to two archegonia each; two cells above

the sixth cell there was another archegonium formed, and a cell above this another one, and branches also gave rise to archegonia. There is no filament that is specially reserved for the formation of archegonia as is sometimes the case with the antheridia. Each archegonium is derived from a single superficial cell.

The archegonia are formed by the division of the initial cell into three cells; the basal cell forms the venter which may or may not be imbedded in the cell of the filament. Some of the division cells of the original cell of the filament grow up around it in such a way as to make it appear as if imbedded (Fig. 65). From the neck cell arises the neck of the archegonium, consisting of four rows of cells, of four cells each (Figs. 60, 62, 63); a uniformity which produces a straight neck to the archegonium.

Occasionally the cells of the two rows on the posterior side, though they do not increase in number, become larger than those on the anterior side (Fig. 62) thus slightly bending the neck toward the anterior side. From the middle cell of the superficial mother cell arises the central cell and the canal cell; the middle cell becomes sharply pointed on the upper end and forces itself between the neck cells; this point is cut off, forming the canal cell; the larger cell divides again into two cells of unequal size: the smaller and upper one forms the ventral canal cell, the lower and larger one forms the egg cell (Fig. 59). When this is mature the canal cells dissolve into mucilage. When the archegonium opens, the four stigmatic cells, which in this species are very large, are not thrown off but fold back (Fig. 63). It is at this stage that the curve in the neck occurs in some archegonia due possibly to the fact that as the filaments grow erect or nearly so, the archegonia occupy the portion of the filaments below the antheridia, and by bending the neck they bring the canal to the oösphere in a more direct line for the capture of the antherozoids, an adaptation tending to secure fertilization. Generally several archegonia are present, but only one seems to give rise to a sporophyte.

The cushion of cells on which the archegonia are borne can hardly be called an archegoniophore as some of these cells give rise to vegetative branches (Fig. 65). Three cases were found where an archegonium arose directly from a cell of the filament without any partition other than that of the formation of the ar-

chegonium. Bower (*l. c.*, Figs. 11, 12) says in his description of the archegonia of *Trichomanes pyxidiferum*, "The archegonia are borne on massive growths (archegoniophores). * * * In one case, however which has a special interest the mass of tissue on which the archegonia are produced is obviously the result of partition of a single cell of a filament, without any marked increase in size having taken place (Fig. 13). This may be regarded as the simplest form of an archegoniophore hitherto described in any fern or even in any Bryophyte and it approaches near to that suggested by Goebel as the simplest possible, in which the sexual organs would be inserted directly on the protonemal threads."

The act of fertilization was not seen, nor the direction of the first wall, but, from later stages they appear to be formed as is common with most ferns; a wall is formed parallel with the long axis of the archegonium, then a cross-wall is formed.

FOOT

The foot is in most cases extremely large, and is in every case a well-defined organ, consisting of a great mass of cells which for the most part contain chlorophyl (Figs. 69, 70, 71). It remains attached to the protonema for some time, having been found in connection with it after the formation of the third leaf (Fig. 75, *a*), and even here it appeared to be in a healthy condition as did also that part of the protonema on which the foot was borne. It grows down into the cushion of the gametophyte (some of the cushion cells appear to grow up around it). The venter cells grow and form a calyptra around the embryo covering it for some little time; remnants of it were found still clinging around the first root after the formation of three leaves (Fig. 75, *b*).

ROOT

The primary root is a prolongation of the main axis of the sporophyte (Figs. 71, 72, 73), while the ultimate roots are always adventitious and produced in acropetal succession. They arise from all sides of the erect rhizome (Fig. 79), the epidermis of which sends out rhizoids. The primary root is persistent and becomes quite long. The second and third roots have a vestigial structure which covers them as the coleorhiza of some endogens

(Fig. 76). The roots are fully formed and have root caps (Fig. 75, *d*). This root cap (Fig. 76) consists of four large pear-shaped cells, inflated on one side; the inflated side is away from the root, the concave side rests on the root tip. They are developed before the root sheath splits. The cells are replaced from the tip and, as the older ones do not always fall off when the new ones have been formed, there have been seen as many as five series (Fig. 77), though they show their age by the partial discoloration of their walls.

The epidermal cells are large and thin-walled; the outer walls often bend into the cavity of the cell and frequently break. The cortex consists of two layers; the cells of the inner layer are very large and have the walls that lie next to the endodermis thickened; but in no instance was the thickening found to be as great as that figured for *Schizaea Pennula*. There is an endodermis of two layers, and the central cylinder (Fig. 78) is like that described by Prantl (Untersuch. Morph. Gefässkrypt., *pl. 4*) for *Schizaea Pennula*.

Sclerosis takes place in all the layers without any marked increase in the thickness of the walls.

RHIZOME

The rhizome is erect (Fig. 79), occasionally creeping. It always forms a protective covering of trichomes over the growing end (Fig. 74, *d*); these trichomes consist of from two to five cells (Fig. 75, *h*), measuring 1 mm. in length which soon turn brown and are persistent. The internodes are of varying lengths. One rootstock (8 mm.) had borne nineteen sterile and two sporophylls, all dead except the five sterile leaves last formed. The fertile leaves measured 6.5 cm., the longest sterile leaf 4.5 cm. Another rhizome of the same length had twenty-two sterile leaves, six green and two nearly brown, with two fertile; these were 7 cm. high, the base of the fertile leaves was green, the sporangia brown and mature. There were twenty-two roots—six short and young; one root was 25 mm. long and had branched; the branches were 5 mm. long.

A cross-section near the young tip shows a central bundle with a well developed endodermis (Fig. 80). Sclerosis takes place in the entire cortex; the different stages are beautifully shown in

young sections; these cells, including the epidermis, are filled with starch. The epidermis and cortex are often invaded by fungal hyphae.

The vascular bundle is concentric; the xylem portion is enveloped in the phloem. The central cylinder is surrounded by a well-defined endodermis and phloem sheath, the radial walls of which are thin and fragile; the phloem elements are represented by two or three imperfect rows of narrow parenchymatous cells and sieve tubes; the xylem consists of scalariform tracheids with occasionally small spiral tracheids close to the phloem. The medullary parenchyma is composed of large, thick-walled cells, pitted, and early showing sclerosis, but not as early as the fundamental tissue outside the bundle.

STERILE LEAVES

The sterile leaves are linear, slender and tortuous. The development of the leaf is very slow, the lower portions having long been fully formed while the apex is still unfolding. The vernation is circinate (Fig. 79). Owing to the more rapid growth of the cells on the dorsal side than those on the ventral, the leaf is rolled up on the ventral side. When fully developed they bear on their dorsal side two rows of stomata alternating with three rows of glands (Fig. 81), sometimes four or more rows of glands. The glands seem to originate from special cells cut off from the epidermis; these epidermal cells frequently do not lengthen, keeping very nearly an isodiametric shape; when they do lengthen the glands remain at or near the upper wall.

The young leaves and the tip of the stem are more or less completely clothed with trichomes early turning brown. These are not to be confounded with the glandular hairs. They are composed of two or more cells and are extremely long, measuring in some instances 1 mm. to 3 mm. or perhaps more. The longest glands of the leaf measured nearly 100 μ, others 76 μ and in width 31 μ. Some are composed of one cell, others of two cells; they are all club-shaped and contain granular protoplasm. These glands were rarely found on the ventral surface, and sometimes they did not appear to follow any law as to their formation on the dorsal surface, though, for the most part, they were formed in alternate rows with the stomata.

The stomata are restricted to two rows of epidermal cells and almost every epidermal cell in these rows gives rise to one (Fig. 82). A cell of the epidermis before it has lengthened forms a U-shaped wall at the upper end of the cell (Figs. 86, *a*, *b*); the points of the U meet the radial wall which separates this cell from the one next above (Fig. 86, *b*); this cell becomes the mother cell of the stoma, and by growth presses the partition wall back a short distance into the upper epidermal cell (Fig. 86, *c*). This cell divides by a tangential wall into two cells of equal size; these become the guard cells (Fig. 86, *c*, *d*) each containing abundant chlorophyl. These guard cells enlarge considerably (Fig. 86, *d*, *e*) so that they are raised above the epidermis as shown in an oblique view (Fig. 83). The wall between the guard cells splits along its central portion making an opening to the space below; the epidermal cell meanwhile has lengthened and the cell above has formed a stoma in the same way. The leaf bundle is more nearly collateral than that of the stem; the xylem faces the ventral, the phloem the dorsal surface of the leaf (Figs. 88, 90). There is a two-rowed endodermis around the bundle; the epidermal cells are large and in some instances occupy one half of the cross section. The ground tissue is made up of thin-walled parenchyma with numerous air spaces (Fig. 89) and the cells contain chlorophyl.

SPOROPHYLL

The sporophyll is very similar to the sterile leaf with the exception of the formation at its apex of pinnae bearing the sporangia; these have been carefully studied by Prantl and others in several species of *Schizaea*, the descriptions of which, from present observations, appear to hold good for *Schizaea pusilla*. One of the largest sporophylls measured 13 cm. from base to apex, the portion bearing the pinnae was 6 mm. long and eight pinnae were formed on one side and seven on the other; the longest pinna measured 4 mm., of this 2⅔ mm. is the portion which bore the sporangia. The lowest pinna on each side had formed four sporangia each, the others eight each. Prantl figures six sporangia for *Schizaea dichotoma*, and sixteen for *Schizaea Pennula*. The edge of each pinna rolls up over the sporangia, forming an indusium, and the end cells at the summit and also along the mar-

gin produce trichomes which also cover the sporangia. These trichomes are often composed of more than one cell, and resemble the trichomes formed by the rhizome and are in some instances as long as 134 μ, 345 μ, 461 μ, the width being 38 μ, and 30 μ.

A surface view of the dorsal side of the sporophyll shows two rows of stomata alternating in some cases with rows of glands, though these sometimes are not in rows, and occasionally only two glands were found. These glands are smaller than those generally found on the sterile leaf measuring only 38 μ.

The stomata appear sunk below the epidermis, but a cross-section showed them to be the same as in the sterile leaf. The two rows of stomata continue up the leaf from the base to the pinnae, where they are lost in a great number of stomata which cover the dorsal surface of the pinnae with no special arrangement. No glands were found on any of the pinnae examined.

The warts or swellings from the epidermal cells are far more numerous in the sporophyll, though they are found on the sterile leaf (Fig. 93, *a*). They do not appear to follow any law as to their arrangement on either leaf, though they appeared to be more numerous on the ventral side. The epidermal walls are thicker than the epidermal walls of the sterile leaf, some of which had extremely thin walls and a rudimentary bundle (Fig. 90).

The bundle has a well-marked endodermis; it appeared from the cross-section to be collateral as did all the bundles with the exception of that of the rhizome (Fig. 94). The elements of the bundle were not traced out, but reticulated and ring tracheids were found in the xylem. The mesophyll tissue of the sporophyll (Fig. 89) is composed of thin-walled cells with numerous air spaces: these cells seem to be branched in a stellate manner in both sterile leaves and sporophylls.

SUMMARY

The spores are small, are nearly reniform, and have a cuticularized exospore which is alveolate. There is a ridge along the concave side having a fissure nearly its whole length through which the young tube emerges when the spore germinates. Out of a great number sown at one time only two had germinated by the end of the third week, the others taking a longer

time. The spore remains attached for some time after the formation of antheridia.

The gametophyte is a filamentous protonema, irregularly branched, bearing both antheridia and archegonia on the same filaments; and producing rhizoids from specially modified cells which are inhabited by a symbiotic fungus.

The antheridia occur singly, or in groups on special branches bearing antheridia alone. They are produced in great numbers though but few ripen. They are simple in their structure and the first wall formed in the antheridium is parallel with the wall cutting it off from the lateral branch, forming a pedicel. A small number of antherozoids are produced in an antheridium, which are enclosed in a membrane when they escape from the antheridium.

The archegonia arise at, or near, the base of the filaments, either directly on the filament or, more often, on cushions formed by the division of the cell of the filament. They are characterized by the uniformity of the neck rows and the large size of the stigmatic cells.

The foot is a large, well-defined organ, remaining attached to the protonema for some time after the formation of the third frond, carrying nourishment from the gametophyte to the embryo which is far advanced before it breaks through the calyptra.

The primary root is persistent. The second and third roots have a vestigial sheath through which they do not break until after the development of the root-cap. The root-cap consists of four large pear-shaped cells inflated on the side away from the root tip.

The rhizome is erect, always forming a protective covering over the growing end; the trichomes are large, turn brown early, and are persistent.

There is a central concentric bundle with a well-marked endodermis. Sclerosis takes place in the entire cortex, the cells of which, with the epidermis, are filled with starch. The epidermis and cortex are often invaded by a fungus hypha.

The sterile and fertile leaves have two rows of large stomata, on the dorsal side, alternating with two or more rows of glands; these glands are small and sometimes wanting on the fertile leaf. The young leaves are more or less completely clothed with

trichomes. Warts or swellings occur from the epidermal cells on both surfaces, though more numerous on the ventral side.

The bundles appear collateral with a well-marked endodermis. The mesophyll tissue is composed of thin-walled cells, branched in a stellate manner.

Explanation of Plates

Plates 1, 2, 3 and 4 were drawn from a magnification three times as great as expressed in the numbers which represent the magnification of the figures as they stand in the reproduction.

PLATE 1

1. Different views of the spore, × 80.

2. Spore, × 140.

3. Portion of exospore, × 333⅓.

4. Ridge and fissure in exospore seen from above, × 195.

5–17. Different stages in the germination of the spore, × 58⅓. *a*, filament; *b*, rhizoid; *c*, *c*, new branch.

18. Germinating spore of *Botrychium obliquum*, two weeks and five days, × 58⅓. Sown at same time as *Schizaea* spores. The last-named did not start to germinate until after three weeks.

19. Germinating spore found in soil on August 28, × 80. *a*, Indication of cross-wall.

20. The same on August 29. *a*, cross-wall formed.

21. The same on August 31, × 30.

22. On September 4, × 30.

23. On September 5, × 30.

24. Spore found in soil on September 5, × 30. *a*, antheridia; *b*, swelling at base of terminal antheridium.

25. The same with wall formed at *a*.

26. Filament of four cells with antheridium showing mother-cells of antherozoids (*a*). *b*, Rhizoid, × 80.

27. Sporangium with spores germinating inside, × 30. Owing to position in which the sporangium fell when sown—the filaments from the spores are not sent out though the regular fissure at *a*.

PLATE 2

28, 29, 30 and 31. Methods of branching of the protonemal filaments.

32 and 33. Cells of the filament dividing.

34 and 35. Cells of the filament becoming moniliform.

36. Young spherical cells with the longitudinal wall (*a*) just forming, × 80.

37. Older stage of the same showing young rhizoids (*a*, *a*) and young branch starting from filament at base of spherical cells *b*, × 80.

38. Portion of filament showing spherical cells, antheridia, and archegonia. *a*, spherical cells; *b*, rhizoids; *c*, fungus in spherical cells; *d*, antheridia; *e*, archegonium, × 30.

39. Shows position of spherical cells, × 30.

40. Abnormal condition. One cell of the filament giving rise to one spherical cell, and a cell of the filament next above giving rise to two, × 30.

41. End of rhizoid showing fungus penetrating into the cell. Shaded portions are hyphae which are inside the rhizoid, × 195.

42. Upper part of same showing portion of spherical cell with the bladder-like hyphae (*b*). A hypha in rhizoid, × 195.

43. Spherical cells filled with fungus *a*, × 140.

PLATE 3

44, 45, 46 and 47. Different ways of branching of antheridial filament.

48. One of the antheridial branches with antheridia in different stages of completion. *a* shows one filament giving rise to three, × 30.

49, 50, 51, 52, 53, 54, 55 and 56. Stages in formation of the antheridium. Fig. 49, × 80, first cell sent out from main filament. Fig. 50, × 30, later stage showing first wall cut off near tip. Fig. 51, × 80, older stage. Terminal cell *a* becomes the antheridium; cell *b* the pedestal. Fig. 52, × 140, *a*, cap cell; *b*, mother cells of the antherozoids. Fig. 53, × 140, later stage. Fig. 54, × 140, ripe antheridium before splitting cap-cell. Fig. 55, × 333⅓, antherozoids still in membrane. Fig. 56, empty antheridium.

57. Branch showing antheridia and archegonia. All the antheridia but *a* are aborted, × 16⅔.

58. Young archegonia, × 140.

59. Young archegonium, × 30. *a*, canal cell; *b*, ventral canal cell; *c*, egg cell.

60. Older stage of same before opening, × 80.

61. Looking down on the four stigmatic cells of the archegonium, × 80.

62. Archegonium opening, × 80.

63. Showing large stigmatic cells (*a*) folding back, × 80.

64. Cell of the filament dividing up before the formation of the archegonia, × 140.

65. The same with an archegonium, × 30.

PLATE 4

66 and 67. Upper and under view of egg cell after fertilization enclosed in the calyptra, × 30.

68. Young embryo, × 30.

69. *a*, gametophyte with archegonium. *b*, foot; *c*, leaf; *d*, stem of sporophyte, × 30.

70. Young sporophyte. *a*, foot; *b*, leaf; *c*, stem; *d*, trichomes; *e*, gland on rond; *f*, calyptra, × 80.

71. Young sporophyte. *a*, foot; *b*, root; *c*, frond; *d*, calyptra.

72 and 73. Two stages in the growth of the sporophyte showing curled tip of frond. Marking the same in both. *a*, gametophyte; *b*, sporophyte; *c*, calyptra, × 12½.

74. *a*, Rhizome; *b*, root; *c*, first leaf; *d*, trichomes.

Plates 5, and 6 were drawn from a magnification twice that expressed in the numbers which represent the magnification of the figures as they stand in the reproduction.

PLATE 5

75. Sporophyte still attached to gametophyte after the formation of the third leaf. *a*, foot; *b*, portion of calyptra; *c*, root; *d*, young root, the dotted lines indicate root-cap which can be seen through the vestigeral covering; *f*, leaf; *g*, rhizome; *h*, trichomes which cover tip of young leaf and rhizome; some have been removed to show glands on leaf; *i*, gametophyte, × 45.

76. Young root just emerging from its covering, × 87½.

77. Root-cap; here shown in five series.

78. Cross-section of root. *a*, thickened inner walls of cells of the ground tissue next to endodermis (*b*); *c*, phloem; *d*, xylem, × 292½.

79. Showing rhizome with four leaves and five roots; *a*, rhizome; *b*, roots; *c*, trichomes (the internode here represented is unusually long and distinct), × 8.

80. Cross-section of rhizome not far from tip, × 120. *a*, cells filled with starch; *b*, endodermis; *c*, phloem; *d*, xylem; *e*, fungus hyphae entering epidermal cells.

PLATE 6

81. Surface view of dorsal side of sterile leaf, showing the two rows of stomata with the glands alternating with them, × 120.

82. Portion of epidermis of sterile leaf with three stomata, *a*, *b*, *c*. *a*, shows the chlorophyl grains; in *b* the contents have been removed to show the original cross-wall (*d*) between the epidermal cells, and the way the guard cells (*e*) rest on epidermis at *c*, × 210.

83. Oblique view of sterile frond showing raised stomata (*a*).

84. Longitudinal section of same. *a*, epidermal cells; *b*, one guard cell of stoma; *c*, air cavity.

85. Cross-section of same. *a*, guard cells; *b*, air cavity, × 210.

86. Five diagrams showing development of stoma. 1 *b*, cross-wall between epidermal cells; 2 *b*, mother cell of stoma with U-shaped wall; *c*, formation of longitudinal wall through mother cell dividing it into the two guard cells; *d*, shows curve in original cross-wall, and the splitting of the longitudinal wall. The dotted line indicates the relative size of the guard cells which have started to swell. In *c*, the stoma is complete; 1 *c*, original cross-wall; 2 *c*, guard cells.

87. Diagram of cross-section of sterile leaf showing the two rows of stomata (*c*). *a*, bundle; *b*, endodermis, × 45.

88. Bundle from sterile leaf. *a*, endodermis; *c*, phloem; *d*, xylem, × 210.

89. Mesophyll tissue from sterile leaf, × 210.

90. Cross-section of a young sterile leaf with a rudimentary bundle, marking as in Fig. 88, × 210.

91. Diagram of cross-section of fertile leaf, marking as in Fig. 87, × 45.

92. Stoma seen in cross-section of sporophyll, × 210. *a*, stoma; *b*, air space.

93. Two epidermal cells from cross-section of sporophyll showing warts (*a*), × 210.

94. Cross-section of bundle in sporophyll, marking as in Figs. 88, 90, × 210.

Studies on the Rocky Mountain Flora.—IV

By P. A. Rydberg

Arnica tomentulosa sp. nov.

A leafy perennial with slender horizontal rootstock. Stem villous, about 4 dm. high: leaves oblanceolate, obtuse, sessile or the lower with short-winged petioles, denticulate, finely villous-pubescent, almost tomentulose, with two pairs of stronger veins, the larger 13 dm. long, somewhat yellowish: heads few, hemispherical; disk about 15 mm. high and 2 cm. broad: bracts ovate or ovate-oblong, obtuse, villous, 12–16 in number: rays light yellow, over 1 cm. long, 4 mm. wide.

This species is nearest to *A. mollis*, but differs in the broad obtuse involucral bracts. It grows at an altitude of about 2700 m.

Wyoming: Buffalo Fork, 1897, *F. Tweedy, 523.*

Arnica tenuis sp. nov.

A low slender perennial with horizontal rootstock. Stem sparingly villous pubescent, about 2 dm. high, monocephalous: leaves usually 3 pairs, sparingly villous when young, entire; the lower two pairs oblanceolate or spatulate, the upper lanceolate: involucre turbinate-campanulate, villous, about 13 mm. high, 10–12 mm. broad: bracts linear, 1–1.5 mm. wide, green; rays orange, 16–18 mm. long and 4 mm. wide.

This species resembles *A. gracilis* in the size of the plant and form of the head, but the leaves are much narrower and the heads solitary. It is intermediate between that species and *A. fulgens*. It grows at an elevation of about 2200 m.

Wyoming: Big-Horn Mountains, 1899, *F. Tweedy, 2094.*

Artemisia diversifolia sp. nov.

A white tomentose perennial with horizontal rootstock. Stems simple, leafy, white-tomentose, 5–10 dm. high: leaves densely tomentose on both sides, subsessile, 5–10 cm. long: the lower pinnately cleft into 3–5 narrowly lanceolate acuminate lobes, which are directed forward: the upper entire, linear-lanceolate, passing into the bracts of the inflorescence: inflorescence a narrow panicle, 1.5–3 dm. long: heads numerous, conglomerate, sessile, 3–4 mm. high and 3 mm. broad: bracts oblong or ovate-oblong, scarious-

margined, densely villous-tomentose: flowers heterogamous, but all fertile, light yellow: receptacle glabrous.

This species belongs to the *A. Ludoviciana* group, and in many respects agrees with the original description thereof. It is, however, a western species, not growing near the region from which *A. Ludoviciana* was described. What the latter really is I have been unable to settle. The one that I think is the only one that has any claim for the name, is a lower plant from Missouri to Colorado, with shorter leaves, more green above, with more divergent lobes and brownish flowers. *A. diversifolia* grows on sandy beaches up to an altitude of 2200 m.

IDAHO: Priest River, 1900, *D. T. MacDougal, 190* (type); Farmington Landing, Lake Coeur d'Alene, 1892, *Sandberg, MacDougal & Heller, 509.*

WASHINGTON: 1889, *G. R. Vasey, 479.*

WYOMING: Yellowstone Lake, 1899, *Aven & Elias Nelson, 6603.*

Picradenia helenioides sp. nov.

A comparatively tall, finely pubescent plant with apparently only biennial root. Stem leafy, about 5 dm. high, with several to many erect branches: leaves rather firm, distinctly ribbed, finely pubescent; the lower petioled and with half clasping bases: basal leaves entire, very narrowly linear-oblanceolate; middle stem-leaves erect, fully 1 dm. long, parted into 3–5 linear divisions: upper stem-leaves linear, entire: heads corymbose: involucre somewhat tomentose, 8–10 mm. high and often 15 mm. broad; outer bracts united only at the base, lanceolate, longer than the inner, 14–18 in number: rays orange, about 1 cm. long, 2–3 mm. wide, 3-toothed at the apex: achenes silky: scales of the pappus broadly lanceolate, acuminate.

It is nearest related to *P. biennis* (A. Gray) Greene; but differs in the yellowish green herbage, the erect branches, the broader segments of the leaves and the darker flowers. It grows in mountain valleys at an altitude of about 2700 m.

COLORADO: On Sangre de Christo Creek, 1900, *Rydberg & Vreeland, 5495.*

Antennaria Piperi sp. nov.

Somewhat surculose-rosuliferous: basal leaves 2–4 cm. long, obovate or oval with a short petiole, densely floccose on the lower surface, only slightly so on the upper surface when young, but

soon glabrate, 1-ribbed or indistinctly 3-ribbed, generally distinctly mucronate: flowering stems 1–1.5 dm. high, somewhat glandulif erous above; its leaves small and bractlike, oblanceolate or linear; heads 5–7 in a short raceme: fertile heads 7–8 mm. high and 6–7 mm. in diameter; its bracts imbricate in about 4 series, slightly floccose, green at the base, purplish in the middle and with a light brownish scarious margin above; the outer short and ovate; the inner lanceolate, acute: pappus very slender, filiform, dirty white; sterile heads about 5 mm. high and about as broad; its bracts broadly oblong, more floccose, brown and with a broader scarious margin of the same color as in the fertile head, obtuse or truncate; pappus only slightly broadened above, white.

It is nearest related to *A. racemosa*, but differs in the more copious and more persistent tomentum, in the broader and brighter colored bracts of the fertile head and the broad scarious margins of those of the sterile one.

OREGON: Olympic Mountains, 1895, *C. V. Piper* (fertile plant in herbarium of Washington Experiment Station, Pullman); mountains of northern Oregon, *Wilkes Expedition* (sterile plant in the Torrey herbarium).

Aster mollis sp. nov.

A strict perennial with a horizontal rootstock. Stem densely villous, almost tomentose, or in age more glabrate, 4–8 dm. high, simple below, with short flowering branches above; leaves obovate to oblanceolate, 5–10 cm. long, densely and softly grayish pubescent on both sides, sessile, slightly clasping, and occasionally a little auricled at the base: heads terminating the short branches, hemispherical; disk about 15 mm. high and broad; bracts herbaceous, oblong, obtuse, villous-pubescent; rays numerous, bluish purple, about 1 cm. long and 2 mm. wide.

This species reaches an elevation of 2200 m.

WYOMING: Big-Horn Mountains, 1899, *F. Tweedy, 2029* (type).

WASHINGTON: Pullman, 1893, *C. V. Piper, 1604*.

Townsendia Vreelandii sp. nov.

A dark green biennial, branching near the base. Stems and branches simple, erect, 1.5–4 dm. high, mostly erect, sparingly villous. Leaves numerous, all oblanceolate, short-petioled, glabrous, mucronate, 4–8 cm. long, 5–8 mm. wide: involucre about 15 mm. high and 25–30 mm. broad: bracts lanceolate, acuminate, scarious, light green with dark green center: rays

bluish purple, 12–15 mm. long, 2 mm. wide: achenes thin, oblong, truncate: pappus of 2 subulate bristles, with a few intermediate squamellae.

It is nearest related to *T. eximia*, but has larger heads, is more leafy, and even the upper leaves are oblanceolate. It grows at an altitude of 2500–3000 m.

COLORADO: Side of Veta Mountain, 1900, *F. K. Vreeland, 639* (type); Veta Pass, 1900, *Rydberg & Vreeland, 5404 and 5405;* West Spanish Peak, *5406.*

Erigeron leucotrichus sp. nov.

Perennial with a somewhat branching rootstock. Stems about 2 dm. high, sparingly villous below, more copiously so above: basal leaves oblanceolate or spatulate, 3–5 cm. long, short-petioled, bright green and sparingly hairy: stem-leaves oblanceolate to linear, 1–2 cm. long; head solitary; involucre white-villous with multiceptate hairs; bracts very numerous, lanceolate, almost black, acuminate with spreading tips: rays very numerous, about 6 mm. long and 1 mm. wide, light purplish pink or white.

This species is nearest related to *E. melanocephalus*, but easily distinguished from it by the white, not black, hairs of the involucre. It differs from *E. simplex* in the taller habit, the larger heads and the darker bracts of the involucre. It grows at an altitude of about 2500 m.

WYOMING: Big-Horn Mountains, July, 1899, *Frank Tweedy, 2003.*

Erigeron incanescens sp. nov.

(?) *Erigeron glabellus* var. *mollis* A. Gray, Proc. Acad. Phil. 1863: 64, in part.

A densely and finely cinereous pubescent plant with perennial rootstock. Stem simple, 1.5–3 dm. high, mostly ascending, striate densely pubescent, leafy: basal leaves oblanceolate or spatulate: stem-leaves about 5 cm. long and 1 cm. wide, oblong, oblanceolate or the upper lanceolate, sessile and somewhat clasping: heads 1–4; disk about 8 mm. high and 15 mm. broad: bracts very numerous in one series, narrowly linear, cinereous as the rest of the plant; rays pale blue or violet, very numerous, about 15 mm. long and less than 1 mm. wide.

From Dr. Gray's description, this species must have been included in *E. glabellus* var. *mollis;* but all specimens that I have

seen under that name belong to *E. subtrinervis* Rydb., which is its nearest relative. From this it differs in the dense grayish pubescence, the narrower stem-leaves, which are not 3-ribbed, and the lower habit. *E. incanescens* grows in rocky places at an altitude of about 3000 m.

COLORADO: West Spanish Peak, 1900, *Rydberg & Vreeland, 5415.*

Erigeron viscidus sp. nov.

A low cespitose perennial. Stems ascending, a little over 1 dm. high, more or less hirsute and glandular-puberulent, especially above; leaves 3–5 cm. long, oblanceolate, dark green, sparingly hirsute and ciliate on the entire margins: heads few: disk about 1 cm. high and 15 mm. broad: bracts very numerous, subequal in one series, narrowly linear, fuscous, acuminate, glandular-puberulent, but not hirsute: rays very numerous, pale blue, about 8 mm. long and .5 mm. wide.

This species is intermediate between *E. glandulosus* and *E. macranthus.* It has the habit of the former, although larger, and the large heads and numerous narrow rays of the latter. It grows in wet ground, at an altitude of about 2700 m.

COLORADO: Near the Gray-Back Mining Camps, 1900, *Rydberg & Vreeland, 5416.*

Valeriana acutiloba sp. nov.

A bright green plant with horizontal or ascending rootstock and polygamo-dioecious flowers. Fertile plant 4–5 dm. high: basal leaves entire with a short wing-margined petiole, 5–7 cm. long; blade spatulate or obovate, acute: stem-leaves usually 3 pairs, pinnately divided; lateral divisions lanceolate to linear, long-acuminate; the terminal one large, oblanceolate or of the uppermost very small leaves linear-lanceolate, entire or saliently toothed: cyme dense, contracted, 2–5 cm. long and about as wide; glandular-puberulent: bracts linear subulate, about 1 cm. long: flowers perfect; corolla funnelform, about 4.5 mm. long; tube proper about 1 mm.; fruit broadly ovate, about 4 mm. long: pappus about 7 mm.: staminate plant lower, 3–4 dm. high, with more sterile shoots, which have much longer leaves: stem-leaves usually only 2 pairs, less divided, with only 1–2 pairs of lateral divisions: cymes denser, flowers all or nearly all staminate: their corollas larger, 5–6 mm. long, more oblique; the limbs about 5 mm. wide.

This species has the dense cyme of *V. capitata;* but the plant is taller, the corolla shorter and is easily distinguished from all its

American relatives by the narrow, long-acuminate divisions of its stem-leaves. It grows in wet places, especially under snowdrifts, at an altitude of 2500–3300 m.

COLORADO: Near Gray-Back Mining Camp, Sangre de Christo Range, 1900, *Rydberg & Vreeland, 5576* (type, fertile plant); Mountain near Veta Pass, *5575* (staminate plants); Bear Creek Cañon, 1895, *Ernst A. Bessey* (fertile); Pagosa Peak, 1899, *C. F. Baker, 620.*

Campanula MacDougalii sp. nov.

A slender glabrous perennial, about 3 dm. high with slender horizontal rootstock. Leaves very thin: the basal ones and lower stem-leaves with slender petioles 2–4 cm. long: blades broadly ovate, 2–3 cm. long, coarsely sinuate-dentate: upper stem-leaves lanceolate to linear, entire; the largest 5–6 cm. long: sepals linear subulate, 10–12 mm. long, at last reflexed: corolla 13–15 mm. long, nearly of the same shape as that of *C. rotundifolia:* style exserted, straight: fruit not seen.

The species is nearest related to *C. Scouleri;* but is easily distinguished from that species by the lack of the sharp toothing of the leaves. The lower leaves resemble somewhat those of *C. rotundifolia,* and were it not for the exserted style and the smaller corolla it may be referred to the var. *Alaskana* of that species.

IDAHO: Priest Lake, 1900, *D. T. MacDougal, 66.*

Castilleja linearis sp. nov.

A rather slender perennial, with a rootstock. Stem simple, 3–4 dm. high, finely villous pubescent: leaves narrowly linear, about 5 cm. long and 2 mm. wide, pubescent, entire or the upper with a pair of narrowly linear lobes: bracts broader, deeply cleft into three linear lobes, tipped with brick-red: calyx villous, 2–2.5 cm. long, cleft almost equally deeply in front and behind, more than half way down: lateral lobes linear, 8–10 mm. long: corolla 2.5–3 cm. long, greenish yellow: galea about 12 mm. long, with red margins: lower lip dark green, about 3 mm. long, 3-lobed.

This species resembles in habit most the subarctic *C. pallida,* but has the corolla of *C. mineata.* It grows in meadows at an altitude of about 2500 m.

COLORADO: Near West Spanish Peak, 1900, *Rydberg & Vreeland, 5619.*

Castilleja trinervis sp. nov.

A tall perennial with rootstock. Stem more or less villous, especially the upper portion, solitary, simple or branched, 3–6 dm. high: leaves dark green, finely puberulent, entire, acute, usually 3-ribbed; the lower linear, 5–8 cm. long and about .5 cm. wide; the upper lanceolate and often 15 mm. wide: lower bracts green, similar but shorter and broader and usually 3–5-lobed: the upper with almost crimson tips: calyx densely white villous, about 3 cm. long, equally cleft in front and behind, each division laterally cleft into two oblong lobes, 5–8 mm. long, tipped with the same color as the bracts: corolla about 4 cm. long, slightly curved, green, but the galea with almost crimson margins: galea about 15 mm. long: lower lip 4–5 mm. long, dark green, with three narrow lobes: style about 5 mm. longer than the corolla.

This species is nearest related to *C. rhexifolia* and *C. confusa*, but is characterized by the copious white villous pubescence of the upper part of the stem and the calyx. It grows in open woods at an altitude of 2700–3000 m.

COLORADO: Headwarters of Sangre de Christo Creek, 1900, *Rydberg & Vreeland, 5620* (type); Gray-Back Mining Camps, *5621*.

Castilleja luteovirens sp. nov.

A simple perennial with rootstock, often turning black in drying. Stem 3–4 dm. high, leafy, slightly pubescent when young, soon glabrate, except the upper portion which is slightly villous: leaves lanceolate to almost linear, 3–4 cm. long, 3–9 mm. wide, finely puberulent, 3-ribbed, acute, entire, or rarely the upper 3-lobed: lower bracts ovate, obtuse, entire, tipped with light greenish yellow or greenish white; the upper ones 3-toothed at the apex and greenish yellow throughout: calyx villous, 15–17 mm. long, almost equally cleft in front and behind, laterally cleft about 3 mm.; lobes lanceolate: corolla 22–24 mm. long, greenish; galea 6–7 mm. long with yellow margins; lower lip 2.5–3 mm. long, bluntly 3-lobed.

This species has been referred to *C. septentrionalis* and *C. pallida*, but differs from both in the broader, less acuminate leaves and broader, more entire yellowish bracts. Neither of the two species mentioned is found in the southern Rockies. Mostly all the material that has been determined as either belongs to the present species. This grows in meadows at an altitude of 1200–2700 m.

COLORADO: Sangre de Christo Creek, 1900, *Rydberg & Vree-*

land, 5616 (type) and *5617;* Wahatoya Creek, *5618;* Middle Park, 1861, *C. C. Parry, 241;* Chicken Creek, 1898, *Baker, Earle & Tracy, 374:* near Denver, 1869, *B. H. Smith;* Ford of Chama, 1859, *Newberry,* in Macomb's Expedition; Seven Lakes, Pikes Peak, 1894, *Ernst A. Bessey.*

WYOMING: Big-Horn Mountains, 1899, *F. Tweedy, 2340;* Laramie Plain, 1884, *C. S. Sheldon, 80.*

UTAH: Salt Lake City, 1879, *M. E. Jones, 1051.*

Mimulus gratioloides sp. nov.

A low, branched annual of more or less reddish color, generally less than 1 dm. high, somewhat viscid puberulent especially above. Leaves oblong-lanceolate, sessile, about 1 cm. long, sinuate-dentate: pedicels slender, in fruit 15–20 mm. long; calyx 7–8 mm. long, cylindraceous in fruit: lobes subequal, short, broadly ovate, acute, ciliate on the margins; corolla yellow, about 1 cm. long and 3 mm. broad, only slightly bilabiate: throat beardless.

This species is nearest related to *M. rubellus* and the specimens from Colorado referred to that species may belong here. *M. gratioloides* differs, however, in the smaller yellow corolla and the acute calyx-lobes. It grows in exposed places among rocks and gravel at an altitude of about 2300 m.

COLORADO: Butte, 5 miles southwest of La Veta, 1900, *Rydberg & Vreeland, 5660.*

Pedicularis lunata sp. nov.

A perennial, perfectly glabrous up to the inflorescense, with a rather stout, but simple rootstock: stem about 4 dm. high, slightly striate and purplish: leaves alternate, dark green, 5–12 cm. long, pinnately divided to near the midrib; segments linear or linear-oblong, crenate: spike 15–20 cm. long, rather lax; bracts pectinately divided with prolonged endlobes, the lower often equaling the flowers in length, slightly arachnoid villous: calyx about 9 mm. long; its teeth broadly lanceolate, about 3 mm. long: corolla pinkish, over 2 cm. long; its tube about twice as long as the calyx, strongly curved; galea strongly arcuate, produced into a rather long beak and almost crescent-shaped; lower lip almost meeting the beak of the upper, very broad, indistinctly 3-lobed with large rounded lateral lobes.

The very broad lower lip, and long-beaked galea suggest somewhat *P. contorta* and *P. ctenophora,* but the corolla-tube is

much longer and the beak not spirally twisted. The species may therefore be placed with *P. Canbyi*, *P. Parryi* and *P. Hallii*, but the corolla and beak are much more arcuate. It is a handsome species growing at an altitude of nearly 2800 m.

WYOMING: Big-Horn Mountains, 1899, *F. Tweedy, 2317* (type).

Pentstemon erosus sp. nov.

A glabrous cespitose perennial, 2–4 dm. high. Basal leaves oblanceolate, short-petioled, 3–5 cm. long, entire, mostly acute: stem-leaves opposite, sessile, oblong or lanceolate, entire, acute or the uppermost acuminate: flowers in a dense interrupted spikelike inflorescence: calyx-lobes broadly ovate, almost cuspidate-acuminate, tinged with dark purple and white and with an erose-dentate margin: corolla purple with very dark limb: lower lip broad with 3 rounded reflexed lobes, bearded on the inside: upper lip with 2 erect narrower lobes: sterile stamens narrowly clavate, short-bearded.

This species is nearest related to *P. procerus*, but easily distinguished by the erose sepals and more reflexed lower lip. It grows at an altitude of 2000–2700 m.

COLORADO: Indian Creek Pass, 1900, *F. K. Vreeland, 615* (type); South Park, 1873, *John Wolfe* (Wheeler Expedition), *293*; Chicken Creek, West La Plata Mountains, 1898, *Baker, Earle & Tracy, 658*.

Pentstemon Wilcoxii sp. nov.

An almost glabrous perennial with a cespitose caudex. Stems 3–6 dm. high, glabrous or slightly puberulent above, simple: leaves opposite, glabrous and somewhat glaucous, dentate with small sharp callous teeth, acute: the basal ones petioled, lanceolate: the lower stem-leaves sessile, oblanceolate or oblong, 3–5 cm. long; the upper lanceolate and slightly clasping: inflorescence an elongated interrupted thyrse: branches 1–2 cm. long, fastigiate-cymose: calyx glabrous, about 4 mm. long, cleft ¾ its length: lobes lanceolate, acute, slightly margined below and there often sinuately toothed: corolla straight, purple, glabrous on the outside, about 15 mm. long; the lower lip longer than the upper, slightly bearded within: sterile stamen club-shaped, with a short dense brown beard.

This species is probably nearest related to *P. humilis*; but easily distinguished by the tall stems, the sharper toothed leaves, and the numerous purple flowers.

MONTANA: Kalispell, 1900, E. V. *Wilcox, 370* (type in United States National Herbarium) and *368*.

Polemonium delicatum sp. nov.

A small glandular perennial with slender horizontal rootstock. Stem very slender, about 1 dm. high: leaves 3–8 cm. long; leaflets 5–11 pairs, very thin, ovate, ovate-lanceolate or oblong, mostly acute, 3–10 mm. long: inflorescence usually branched; branches 3–4-flowered; pedicels slender, 5–15 mm. long; calyx glandular, 4–5 mm. long: lobes lanceolate, acute: corolla blue, open-campanulate, about 7 mm. high and 8 mm. broad: stamens about equalling the corolla.

This is nearest related to *P. parviflorum* Nutt., but is still smaller and characterized by its slender pedicels, small flowers and acute calyx-lobes. It grows at an altitude of over 3000 m.

COLORADO: West Spanish Peak, 1900, *Rydberg & Vreeland, 5720* (type).

COLORADO or NEW MEXICO: Canadian?, *Dr. James.*

Polemonium speciosum sp. nov.

A low viscid-villous plant, cespitose with a perennial rootstock. Stem 1–2 dm. high with 2–3 leaves: basal leaves numerous, 8–15 cm. long with wing-margined rachis; leaflets opposite, 7–9 pairs, ovate, 6–12 mm. long, acute: stem-leaves similar but smaller: inflorescence capitate: calyx viscid-villous, 15–20 mm. long, cleft to about the middle: lobes lanceolate, acute: corolla pale blue, deeply campanulate-funnelform, 2–2.5 cm. long: limb about 1.5 cm. broad.

The form of the corolla, the dense capitate inflorescence and the viscid pubescence place this species nearest *P. viscosum*, and *P. confertum*, but the leaflets are not verticillate, the corolla is larger than that of the former and broader than in the latter.

COLORADO: Mount Garfield, 1900, *Fred. Clements.*

Gilia candida sp. nov.

A glandular perennial with short caudex. Stems often more than one, ascending or erect, simple, 4–6 dm. high, leafy: leaves rather fleshy, divided into linear-filiform, spinulose-tipped segments; the upper gradually smaller: inflorescence a very narrow panicle: branches usually very short and few-flowered: flowers subsessile: calyx glandular-pubescent, about 8 mm. long; its lobes lanceolate, bristle-tipped: corolla white, or rarely pale pink, 2–3

cm. long, salverform: its lobes oval or obovate, obtuse: stamens inserted unequally below the throat, included.

This species is nearest related to *G. aggregata;* but differs in the white corolla and its rounded obtuse lobes. It is also lower and the upper leaves more reduced. It grows on dry hillsides at an altitude of 2000–2700 m.

COLORADO: Mesas near La Veta, 1900, *F. K. Vreeland, 602* (type); Veta Pass, 1900, *Rydberg & Vreeland, 5730;* Calham, 1893, *De A. Saunders.*

Phacelia alba sp. nov.

A viscid-villous annual or biennial, 2–4 dm. high. Stem leafy, strict and simple viscid-villous and glandular above: leaves twice interruptedly pinnatifid, about 1 dm. long, glandular-puberulent, hispid ciliolate on the margins and veins; ultimate segments ovate or oblong, 3–6 mm. long: inflorescence branched, dense, in flowers almost capitate, but branches in fruit spiciform: flowers nearly sessile, 2-ranked: calyx glandular, cleft to near the base; sepals broadly linear, obtuse, about 2 mm. long, about one third shorter than the white corolla: the lobes of the latter rounded, crenate: appendages 10, broadly ovate: stamens and style much exserted: capsule ovoid, about 6 mm. long: seeds often solitary in each cavity, finely pitted.

This species is nearest related to *P. Neo-Mexicana* and *P. Popei*, resembling the latter most in habit, but having the viscid-pubescence and the crenate corolla-lobes of the former. It differs from both in the small white corolla and the long-exserted stamens. It grows in mountain valleys at an altitude of 1800–3000 m.

COLORADO: Sangre de Christo Creek, 1900, *Rydberg & Vreeland, 5755* (type); Valley of Upper Arkansas River, 1873, *John Wolfe* (Wheeler Expedition), 99; Headwaters of Clear Creek, 1861, *C. C. Parry, 314.*

NEW MEXICO: Ruidoso Creek, White Mountains, 1895, *E. O. Wooton.*

Lappula calycosa sp. nov.

A hirsute annual, simple below, branched above with long virgate branches. Stem hirsute, 3–4 dm. high: leaves oblong, obtuse, 3–4 cm. long, 7–8 mm. wide; those of the branches smaller: pedicels short, in fruit 2–3 mm. long, generally 4 mm. below the leaves; corolla pale blue, about 1.5 mm. long and 1 mm. broad: calyx-lobes enlarged in fr it, foliaceous, 4–6 mm.

long and reflexed: fruit about 4 mm. in diameter: nutlets surrounded by a single row of subulate glochinate prickles, somewhat flattened at the base but not united into a wing-border: back of the nutlets strongly muricate.

It is nearest related to *L. occidentalis* (Wats.) Greene, but differs in the oblong obtuse leaves, the enlarged and reflexed fruiting calyx-lobes, and the virgate branches. It grows in deserted fields at an altitude of about 2000 m.

COLORADO: Walsenburg, 1900, *Rydberg & Vreeland, 5715.*

Lappula cupulata (A. Gray)

Echinospermum Redowskii var. *cupulata* A. Gray, Bot. Calif. 1: 530. 1876.

I think that this should be regarded as distinct from *L. Texana* (Scheele) Britton, as the habit is quite different. *L. cupulata* is diffuse, branching at the base, with elongated branches, while *L. Texana* is simple at the base, and branched above with short branches.

L. Texana is a southern plant, ranging from Texas to New Mexico. The range of *L. cupulata* is from Nevada to Nebraska, south to Colorado.

Cryptanthe minima sp. nov.

A dwarf hirsute annual, beginning to bloom when only 1 cm. high. Stems several, erect, in the specimens seen only 1–4 cm. high, long hirsute: leaves spatulate or oblanceolate obtuse, hirsute on both sides, 5–15 mm. long and 2–3 mm. wide: flowers crowded, 2.5–3 mm. long, subsessile: lobes of the calyx linear, hispid: corolla white; limb a little over 1 mm. broad; nutlets whitish, about 1 mm. long, dissimilar; 3 ovoid, strongly muricate; the fourth somewhat larger, smooth; the inside edge with a slender groove, triangular-dilated at the base.

In size and general habit, this species is strikingly like *C. pusilla;* but the fruit is different; the nutlets being dissimilar, one of them smooth, and all with rounded lateral angles and more rounded backs. The specimens of our collection are rather young and only two fully developed fruits were found. *C. minima* was found on dry hillsides at an altitude of about 2200 m.

COLORADO: Cucharas River, above La Veta, 1900, *Rydberg & Vreeland, 5697.*

Mertensia lineariloba sp. nov.

A slender perennial with glabrous simple stem, 2–3 dm. high, basal leaves 5–15 cm. long, long-petioled; blades oblanceolate, obtuse; stem-leaves subsessile, linear or linear-lanceolate, acute, 3–6 cm. long, 4–9 mm. wide, strigose above, glabrous beneath: flower clusters 3–4-flowered in the axils of the upper leaves; pedicels very slender, 2–6 mm. long, strigose: calyx divided to near the base; lobes linear, acute, 3–4 mm. long, almost equaling the tube of the corolla, glabrous on the back, but hispid ciliate on the margins: corolla blue, 7–8 mm. long, tube nearly of the same length as the throat and limb; the latter 4–5 mm. long: stamens almost equaling the corolla; filaments dilated, and broader than the anthers.

It is nearest related to *M. linearis*, but characterized by the narrow, strongly ciliate calyx-lobes and the filiform pedicels. It grows in shaded situations at an altitude of 2500–2700 m.

COLORADO: West Indian Creek, Trichera Range, 1900, *Rydberg & Vreeland, 5691* (type); near Empire, 1885, *H. N. Patterson, 115*.

Mertensia ovata sp. nov.

A low cespitose, somewhat fleshy perennial. Stems 1–1.5 dm. high, glabrous: leaves 2–5 cm. long, 1–1.5 cm. wide, minutely strigose above, glabrous beneath; the lower obovate and short-petioled; the upper broadly ovate and sessile: flower-cluster dense; pedicels very short: calyx cleft to near the base: sepals lanceolate, ciliate on the margin, about 4 mm. long and one third shorter than the corolla-tube: corolla 10–12 mm. long; its tube nearly one half longer than the throat and limb: the latter about 7 mm. broad: stamens nearly equaling the corolla; filaments dilated and broader than the anthers.

This species is probably nearest related to *M. lanceolata;* but differs in the stunted habit and the broad leaves. It grows among rocks, at an altitude of 2800–3500 m.

COLORADO: West Spanish Peak, 1900, *Rydberg & Vreeland, 5690* (type) and *5690a*.

Mertensia obtusiloba sp. nov.

A low cespitose perennial. Stems ascending, glabrous, 1–2 dm. high: lower leaves spatulate or oblanceolate, obtuse, tapering into a winged petiole, dark green, glabrous beneath, minutely strigulose above, glabrate in age, 3–5 cm. long; the upper broadly lanceolate, sessile: flower-clusters several from the axils of the

upper leaves: pedicels very short, often sparingly strigulose: calyx divided to near the base; sepals oblong, obtuse, ciliate on the margins, 2–3 mm. long, scarcely more than half as long as the tube of the corolla: corolla dark blue, about 7 mm. long: tube nearly equaling the throat and limb: stamens short, included in the tube, filaments very short, not broader than the anthers.

This species is nearest related to *M. Tweedyi*, but differs in the shorter, obtuse calyx-lobes, the broader and thinner leaves and the stem which is not depressed or prostrate. It grows at an altitude of 2000–3500 m.

COLORADO: Pikes Peak, 1900, *Fred. Clements* (type); Garden of the Gods and Pikes Peak, 1894, *Ernst A. Bessey;* Argentine Pass, 1878, *Marcus E. Jones, 54.*

Mertensia membranacea sp. nov.

A tall erect perennial with a rather thick tap-root. Stem glabrous or sparingly hirsute above, 6–8 dm. high: leaves all petioled, or the upper sessile; blades ovate, acute or more often short acuminate, 4–8 cm. long, 1.5–4 cm. wide, very thin, hispid-stringulose on both sides: flower-clusters terminal and in the axils of the upper leaves, branched and many-flowered: pedicels 5–10 mm. long, hispidulous: calyx-lobes 2–3 mm. long, hispidulous, lanceolate, acute, one-third or one-fourth as long as the tube of the corolla: corolla about 1 cm. long; the pale blue or almost white tube longer than the dark blue limb and throat: limb about 4 mm. broad: stamens much shorter than the limb; filaments dilated and broader than the anthers: nutlets strongly rugose and spotted.

This species is related to *M. paniculata*. Mr. Bessey and myself collected it in 1897, but as the specimens were rather poor, they were referred doubtfully to that species. As more and better specimens have now been received, it has been possible to draw a description. It differs from *M. paniculata*, in the thinner leaves which almost always show an acumination, in the short calyx-lobes which scarcely enlarge in fruit and the smaller and numerous flowers. It grows in moist places at an altitude of 300–2000 m.

IDAHO: Priest River, 1900, *D. T. MacDougal, 3* (type); Cedar Mountain, 1892, *Sandberg, MacDougal & Heller, 420.*

MONTANA: Electric Peak, 1897, *Rydberg & Bessey, 4864.*

Mentzelia ctenophora sp. nov.

A diffuse cespitose scabrous perennial. Stems 3–6 dm. long, branched, in age straw-colored: lower leaves linear or linear-lan-

ceolate in outline, tapering at both ends, often 2 dm. long: the upper lanceolate with a broad base: all pectinately laciniate with linear-oblong divergent obtuse lobes; hypanthium cylindrical, 15–18 mm. long; sepals ovate-lanceolate, acute, 4–5 mm. long: petals obovate, light yellow, about 8 mm. long: seeds irregularly angled, but not winged, finely muricate.

This species is perhaps nearest related to *M. albicaulis*, but differs in the large size of the plant, the diffuse habit, and the larger flowers. It was collected on railroad banks and in loose barren soil on hillsides, at an altitude of 1800–2100 m.

COLORADO: On Cucharas River, below La Veta, 1900, *Rydberg & Vreeland, 5769* (type); near Walsenburg, *5768*.

Impatiens aurella sp. nov.

A slender glabrous annual, about 6 dm. high. Petioles 1.5–3 cm. long: leaf-blades ovate or oval, thin, bright green, a little paler beneath, 4–5 cm. long, coarsely toothed, acute; teeth and apex finely mucronate: peduncles ascending, mostly 2-flowered: bracts minute, linear, about 2 mm. long: flowers orange, not mottled: sack conical, about 1 cm. long and 6 mm. broad at the base; its spur recurved, about 8 mm. long.

This is nearest related to *I. biflora*, but differs in the much smaller flowers, which are scarcely more than half the size of that species and without any spots, the comparatively longer spur and less pale leaves. It grows in swamps at an altitude of about 600 m.

IDAHO: Priest River, 1900, *D. T. MacDougal, 20*.

Geranium nervosum sp. nov.

A tall perennial with thick root and short caudex. Stems 4–8 dm. high, minutely retrorsely strigose, in age more glabrate: basal leaves with petioles 2–4 dm. long; blades reniform in outline, 8–12 cm. in diameter, finely strigose on both sides, divided to near the base into 5–7 obovate-cuneate or oblanceolate-cuneate divisions which are again 2–3-cleft and coarsely toothed: stem-leaves none, except those subtending the inflorescence; these sessile, 3–5-cleft; branches of the cymes and calyx very densely glandular pubescent: sepals oval, 8–9 mm. long, terminated by a filiform tip, 1–2 mm. long: petals broadly obovate, 15–18 mm. long, pale violet or almost white, with dark purple streaks: carpels as well as their column densely glandular; the latter nearly 2 cm. long: style beyond the column about 5 mm.: seeds glabrous, minutely reticulate.

This species is somewhat intermediate between *G. viscosissimum*

and *G. Richardsonii*, having the general habit, the leaves and pubescence of the stem of the latter, but the densely glandular pubescence of the inflorescence and the calyx and carpels of the former. The color of the flower is most like *G. Richardsonii*, but scarcely pure white and with much more prominent veins. It grows at an altitude of 1800–2700 m.

WYOMING: Fish Creek, Teton Forest Reserve, 1897, *F. Tweedy, 494* (type).

COLORADO: Continental Divide, Routt County, 1894, *C. S. Crandall.*

Lupinus candicans sp. nov.

A low cespitose perennial, densely white-silky throughout. Stems ascending, 1.5–2 dm. high, 3–4-leaved, often branched: stipules linear subulate, 5–8 mm. long: petiole 3–8 cm. long: leaflets about 7, densely white-silky and shining, 1.5–2.5 cm. long, oblanceolate, acute, mucronate, mostly conduplicate: raceme rather dense, 3–8 cm. long on a peduncle 2–5 cm. long: bracts small and early deciduous: calyx densely silky-villous, only slightly saccate on the upper side; lower lobe about 4 mm. long: banner dark blue with a light brown spot, about 7 mm. long, very broad, and with the sides strongly reflexed; wings dark blue, as well as the banner glabrous, about 9 mm. long and about equaling the keel: the latter whitish, tipped with dark purple: pod densely white-silky, 3–4-seeded.

This species has the white pubescence of *L. sericeus* and *L. Hellerae;* but is in every way a much smaller and more cespitose plant: the flowers are much smaller and of a darker and more intense blue.

MONTANA: (locality not given), 1900, *E. V. Wilcox, 451* (type in U. S. Nat. Herb.); Boulder, *125* and *129*, in part; Big Timber, *385;* Highwood Mountains, *42;* Columbia Falls, 1897, *R. S. Williams.*

Lupinus cyaneus sp. nov.

A stout and tall perennial with rather simple caudex. Stem 4–9 dm. high, densely villous, but not white, very leafy and in age somewhat branched: stipules subulate, over 1 cm. long: petioles 5–10 cm. long: leaflets 7–11, oblanceolate, 3–9 cm. long, glabrous above, almost velvety beneath, acute: raceme long and dense, 1.5–2 dm. long: bracts rather persistent, often over 1 cm. long: flowers very numerous, 2–4 in each verticil, very short-pediceled: calyx white-velvety, somewhat saccate above: lower lobe about

8 mm. long: banner slightly hairy on the back, light blue, with a light brownish spot at the center, about 8 mm. long: wings light blue, about 1 cm. long, equaling the keel, which is whitish with purple tip: pod densely silky-villous, about 25 mm. long and 8 mm. wide, 4–5-seeded.

This species has the general habit and the long dense raceme of *L. leucophyllus*, but is much greener and the flowers are much smaller and lighter in color. No. 435, cited below, is referred here doubtfully. It is more silvery and more branched and had apparently almost white flowers.

MONTANA: (locality not given), 1900, *E. V. Wilcox, 446* (type in U. S. Nat. Herb.); Coal Spur, *435* (?) and *449* (the latter in fruit); Gallatin Valley, 1896, *J. H. Flodman, 617*.

Astragalus sulphurescens sp. nov.

A light green cespitose perennial. Stems ascending, about 4 dm. high, angled, glabrous, somewhat branched: stipules ovate to lanceolate, membranaceous, free from the petioles: leaflets 13–19, elliptic, obtuse or acutish, mucronulate, 12–30 mm. long, with a few scattered strigose hairs: spike dense and elongated: flowers ascending: bracts lanceolate-subulate, about 8 mm. long: calyx white-strigose with scattered black hairs: tube about 5 mm. long: lobes almost filiform, fully 5 mm. long: corolla light yellow: banner narrow, 15–18 mm. long, much exceeding the wings and keel: wings very narrow, only about 1.5 mm. wide: pod 2-celled, with dorsal suture deeply inflexed, deeply obcordate in section, about 1 cm. long, 3–4 mm. wide, strigose, with black hairs.

This species is closely related to *A. adsurgens*, but differs in the yellow, ascending flowers, narrow petals, more scant pubescence, the long slender calyx lobes and the black hairy pod. It grows at an altitude of 1600–3000 m.

COLORADO: Georgetown, 1895, *P. A. Rydberg* (type); along Platte River, Denver, 1878, *M. E. Jones, 851*.

Aragallus villosus sp. nov.

Densely and intricately cespitose perennial. Leaves basal, numerous, 5–10 cm. long: leaflets 25–31, rather crowded but not verticillate, 1–1.5 cm. long, lanceolate, very acute, densely but somewhat loosely silky: scape about 1.5 dm. long, loosely silky, almost hirsute, with spreading hairs: spike dense, 4–5 cm. long: bracts linear or narrowly linear-lanceolate, 8–10 mm. long: calyx

white-silky villous; lobes very short, about 2 mm. long: corolla ochroleucous without any purple, 12–15 mm. long: keel very short and round, abruptly tipped with a small tip: pod thin, perfectly 2-celled, white-silky, about 1.5 cm. long, more than twice as long as the calyx, tipped with a slender beak which is abruptly hooked at the apex.

This belongs to the *A. campestris* group and is characterized by the coarse spreading pubescence of the scape and the ochroleucous flowers without any trace of purple.

MONTANA: Craig, 1900, *E. V. Wilcox, 378* (type in U. S. Nat. Herb.).

Trifolium lilacinum sp. nov.

A densely cespitose dwarf subscapose perennial with very deep root. The short branches of the caudex covered with the scarious stipules and remains of old leaves: leaves 3-foliolate, bright green; petioles 2–6 cm. long, strigose: leaflets elliptic or lanceolate-oblong, acute at each end, 1–2.5 cm. long, strigose: peduncle 5–12 cm. long, bracts minute, less than 1 mm. long, 3-toothed: flowers reflexed in fruit: calyx densely strigose; tube 3 mm. long; teeth subulate-filiform, 4–6 mm. long: corolla pale rose-purple or lilac, in age turning light brownish, about 1 cm. long; banner straight and obtuse.

This species is related to *T. dasyphyllum*; differing in the minute 3-toothed bracts and their shorter and comparatively broader leaflets. It is still nearer related to *T. acuminatus* Greene; from which it is distinguished by the smaller flowers and the not acuminate banner. It is an alpine plant growing among rocks at an altitude of about 3000 m.

COLORADO: West Spanish Peak, 1900, *Rydberg & Vreeland, 5950* (type), *5951* and *5952*.

Lathyrus leucanthus sp. nov.

A glabrous or slightly pubescent perennial with a very slender rootstock. Stem about 3 dm. high, angled: stipules very narrow, semi-sagittate: leaflets 2–4 pairs, elliptic, veiny, glaucous, acute, mucronate, 1–3 cm. long, 3–10 mm. wide: tendrils of the lower leaves mere tips; of the upper elongated and sometimes 3-divided: racemes short, in the axils of the middle leaves, 3–4 cm. long, 2–4-flowered: calyx glabrous, cleft to about the middle: lobes lanceolate, acuminate: corolla white, about 15 mm. long: banner broad.

This is nearest related to *L. Arizonicus*, but differs in the broader leaves and banner. It grows at an altitude of 2400–3000 m.

COLORADO: Ojo, 1900, *Rydberg & Vreeland, 6020* (type); Pass Creek, *6021;* West Indian Creek, *6022;* mountain near Veta Pass, *6023;* Veta Pass, 1890, *Mr. and Mrs. G. H. Hicks, 19;* Ridgway, 1895, *F. Tweedy, 239.*

New and noteworthy Northwestern Plants.—V.

By C. V. Piper

Arabis Whitedii

Perennial from a simple or more or less branched caudex, the tap-root rather slender: flowering stems one to several, usually few-branched from the lower part, sparsely and rather coarsely stellate pubescent throughout, but the plant greenish in appearance: branches erect, virgate, in fruit 2–5 dm. long: radical leaves tufted, oblanceolate or spatulate, entire or with a few coarse teeth, mostly obtuse, equally pubescent on each side, 2–6 cm. long, the margined petiole about equaling the blade: cauline leaves several, sessile, not auriculate, 2–4 cm. long, oblanceolate, obtuse, mostly entire: flowers white, at length forming racemes 2–3 dm. long, the pedicels 1 cm. long, spreading: sepals greenish, 3 mm. long: petals white, obovate, oblong, obtuse, usually faintly dentate at apex: filament narrowly triangular, broader than the anthers: stigma bilobed: pods striately erect, stellate, 2–3 cm., long, 1 mm. wide, the style short and stout, the seeds making prominent swellings: perfectly formed mature seeds not seen.

Type specimens collected at Wenatchee, Wash., by *Whited*, no. 1057, April and May, 1899; also collected by *Sandberg & Leiberg*, no. 275, at Junction of Crab and Wilson Creeks, Duylos Co., Wash., June 22, 1893. Nearest *A. Nuttallii* Rob.

Trifolium arcuatum

Stems one or several from a stout vertical root, erect or somewhat divergent, simple, striate, terete, nearly glabrous or the whole plant weakly hirsute, 2–3 dm. high: cauline leaves two or three, the leaflets elliptic or oblong, obtuse, 1–3 cm. long, usually shorter than the petioles; leaflets of the radical leaves shorter and broader, sometimes retuse; all minutely serrulate or the lower nearly or quite entire; stipules large, 1–3 cm. long, lanceolate, adnate for two thirds their length, entire or nearly so: heads globose, 1–3 cm. in diameter: flowers numerous, ochroleucous, soon reflexed, 10–12 mm. long, nearly sessile: calyx-tube campanulate, 2 mm. long, the anterior lobe about twice as long, the four others scarcely exceeding the tube, all linear-subulate, more or less strongly curved especially at the tip: corolla about 12 mm. long, three times as long as the longest calyx-lobe: ovary

2-ovuled: pod lenticular, 1-seeded, villous near the base of the style on the anterior face with long hairs.

Nearest related to *T. eriocephalum* Nutt. but with a very different calyx. Specimens examined:

WASHINGTON: Simcoe Mountains, *Suksdorf*, no. 270, 6 June 1884 (type); Blue Mountains, Columbia County, *Horner*, no. 278.

OREGON: Blue Mountains, *Douglas*, *Nevius* in 1874; Union County, *Cusick*, no. 943 in 1881.

Astragalus sinuatus

Apparently decumbent, a decimeter or so high, the stems 3 dm. or more long, somewhat zigzag: whole plant pubescent with short curved white hairs: leaves 4–5 cm. long, the petiole short; leaflets about six pairs, 10–12 mm. long, elliptic, truncate or slightly retuse at apex, broadest just below the middle, attenuate into an acute base, very shortly petiolulate; stipules small, deltoid-acuminate: peduncles axillary, about 6 cm. long, exceeding the leaves: flowers not seen: pedicels in fruit 4 mm. long: pods thick-walled, curved, stipitate, 3–3.5 cm. long, including the 1 cm. long stipe which is included in the calyx, turgid, rugulose, pubescent like the rest of the plant, sharply acuminate at apex, dehiscing for one fourth its length, the sutures not at all inflexed; before dehiscence the outer layer of the pod becomes loosened in short sinuous folds along the dorsal suture.

Eastern Washington, without definite locality, Brandegee, no. 739 in 1883.

This species is nearest *A. sclerocarpus* Gray, but its very different leaves and shorter stiped pods mark it as distinct.

Solidago caurina

Stems 6–8 dm. tall, terete, sparsely puberulent with white curved hairs, or below quite glabrous: leaves numerous, lanceolate, sessile, scarcely triple-nerved, little reduced above, 5–6 cm. long, 1–2 cm. wide, entire or little serrate, acute or sometimes cuspidate, glabrous except the scabridulous margins, and the nerves beneath, which are slightly puberulent: panicle virgate, narrow, 1.5–2 dm. long, rather loosely flowered; branches of the lower half or two thirds from the axils of slightly reduced leaves; heads 4–5 mm. high, about 15-flowered: involucre glabrous, the bracts loosely two-ranked, lanceolate, not flaccid, broadest at base, acute, more or less ciliate with rather coarse hairs, the midrib prominent: outer bracts decidedly shorter: branches and peduncles pubescent with short curved hairs.

Klikitat Co., Wash., *Suksdorf*, no. 30, August 31, 1881; Cascade Mts., Wash., above Lake Chelan, *Lake & Hull*, no. 818, 25 August, 1892 (type).

Nearest *S. elongata* Nuttall, differing in its leafy bracted, less densely flowered, narrower panicle, and the stiffer broader involucral bracts which are inclined to be of two lengths.

Erigeron Leibergii

Perennial from a stout usually multicipital caudex, sparsely hirsute and glandular throughout: stems slender, 10–15 cm. high, erect or spreading, mostly simple and monocephalous: radical leaves tufted, broad spatulate or oblanceolate, 4–9 cm. long, 1–2.5 cm. wide, obtuse, entire; cauline leaves rather many, oblong, usually acute, sessile, 1–2 cm. long: peduncle short: heads rather small, 6–7 mm. high; involucral bracts linear, acuminate, not more pubescent than other parts of the plant, in about two series: rays pale violet, 20 to 25 in number, 1 cm. long: pappus simple: akenes hispidulous.

Mt. Stuart, Wash., 8000 feet alt., *Sandberg & Leiberg*, no. 810, 28 Aug., 1893.

This species is not very close to any described in the Synoptical Flora, nor does it seem referable to any of the numerous species published since then.

Antennaria latisquama

Apparently densely tufted from stout, subterranean multicipital caudexes, the pistillate plants 6–10 cm. tall: the staminate somewhat shorter: radical leaves lanceolate-spatulate, 2–4 cm. long, 3–5 mm. wide in the widest part, mostly acute, appressed pubescent on each side: cauline 2–4, narower and more acute, the uppermost equaling or exceeding the head: pistillate heads oblong, 12–13 mm. long, 6 mm. wide, its bracts closely imbricate, the outer ovate to ovate-oblong, acuminate, lanate on the exposed parts, hyaline tinged with pale brown and pink, the inner paler, glabrous, linear, acuminate, all entire: staminate head broadly turbinate, lanate especially at base, about 8 mm. long, the dark-brown bract in four successively shorter ranks, mostly obtuse and entire: ♀ pappus of sparsely denticulate bristles: ♂ pappus not rarely branched, denticulate, not enlarged at apex: immature akenes glabrous.

Collected in Klikitat Co., Wash., by *Howell*, no. 417, May, 1882, and by *Suksdorf* near Columbus, 13 April, 1886.

Apparently nearest *A. dimorpha* T. & G., from which its taller habit and very different heads easily separate it.

Artemisia Suksdorfii

Artemisia heterophylla Nutt. Trans. Am. Phil. Soc. II, 400. 1841. Not Besser. 1834.

Artemisia vulgaris var. *Californica* Besser, Linnaea, **15**: 91. 1841, and Gray, Syn. Fl. **2**[1]: 373, in part. Not *A. Californica* Lessing. 1831.

Herbaceous perennial, the numerous usually simple stems in large tufts, 1–1.5 meters high: stems terete, coarsely striate, sparsely pubescent when young, glabrate: leaves numerous, mostly lanceolate, but sometimes broader, acute, entire or sparingly dentate or even laciniate, 6–10 cm. long, bright green and glabrate above, densely tomentose beneath with a permanent white tomentum: panicle pyramidal or elongate, 3–6 dm. long, the lower suberect branches from the axils of scarcely reduced leaves, the upper branches short and densely congested: heads cylindrical-oblong, small, 3–4 mm. long, 5–8-flowered: involucre pale green, shining, sparsely floccose, pubescent when young, glabrate: bracts obtuse, with a very narrow hyaline margin: flowers glabrous or with but few glands.

This *Artemisia* is common on the bluffs of Puget Sound and ranges from British Columbia to north California, apparently always in the immediate proximity of the sea. It has been distributed by Suksdorf under another varietal name that has already been used. The following specimens have been examined:

BRITISH COLUMBIA: Burrard Inlet, *Macoun*, 27 July, 1887.

WASHINGTON: Fairhaven, *Suksdorf*, no. 980, 5 July, 1890 (type); *Piper*, no. 2508; *Henderson*, in 1892; Seattle, *Piper*, in 1897; Montesano, *Heller*, no. 3976.

OREGON: Chetco, "by the sea," *Howell*, no. 147, June, 1884.

CALIFORNIA: Sea coast, Shelter Cove, Humboldt Co., *Bolander*, no. 6482.

Crepis glareosa

Perennial, tufted, with one to five stems from a stout caudex, 8–12 cm. high, sparsely white tomentose throughout, not at all hirsute: stems stout, scarcely striate, bearing one to three heads: leaves oblanceolate, 4–7 cm. long, usually deeply pinnatifid into acute slender lobes, rarely nearly entire: heads 2 cm. high, on stout peduncles about 3 cm. long; involucre of about 12 acute

hyaline-margined bracts, 10–12 mm. long, these pubescent along the middle with long curled white hairs, and tomentose at base: flowers about 15: mature akenes cylindric, slightly constricted at the apex, not beaked, pale greenish or yellowish, 10-striate, not costate, 7 mm. long, the copious white pappus 5 mm. long.

Collected by the writer at Ellensburg, Wash., 20 May, 1897, no. 2704. The pubescence of the involucre is just that of *C. rostrata* Coville, but the present plant differs in its smaller size, its very different akenes, and in the absence of hirsute pubescence.

Dodecatheon viscidum

Whole plant even to the calyx and capsule viscid puberulent with stipitate glands: caudex short, bearing many coarse fibrous roots: leaves lanceolate or oblong, obtuse, entire, 3–6 cm. long, narrowed at base into a petiole half as long: scapes usually single, stoutish, erect, 3–4 dm. high: umbel one- to several-flowered: calyx-lobes narrowly triangular, attenuately acute, four times as long as the tube, about one half as long as the capsule: corolla reddish: stamens free to the very base, the flat filaments short and included in the throat of the corolla: capsule cylindric, narrow, 10–15 mm. long, tipped by a style of nearly equal length, circumsessile near the apex when ripe.

Collected by the writer ten miles west of Spangle, Wash., 24 May, 1898. The specimens are in fruit, only a few shrivelled flowers being found. The species is nearest *D. conjugens* Greene, from which its glandular character easily distinguishes it. The plant was found on a grassy hillside in one spot only, and is apparently very rare.

Gilia Klikitatensis Suksdorf in herb.

§ Navarretia. Annual, erect, slender, strict, 5–20 cm. tall, the stem merely puberulent: cauline leaves frequently opposite, 1–2 cm. long, pinnately 5–7-divided into filiform acerose segments, these again more or less pinnately spinescent, puberulent, becoming glabrate: flowers densely glomerate in a single terminal cluster, rarely two or three, the heads 1–2 cm. in diameter; bracts like the leaves but rather more spinescent, especially the caudal termination, the whitish rhachis more or less broadened and flattened, its dorsal surface and edges covered with soft retrorse white hairs, the segments merely puberulent: calyx-tube largely scarious, pilose, the unequal more or less spinose lobes and the veins greenish: corolla pale (lavender?), 8 mm. long, its slender tube equaling or exceeding the calyx-lobes, its own lobes obovate, distinctly

narrowed below: stigmas and ovary-cells always three: ovules solitary in the cells.

WASHINGTON: Klikitat County, near the mouth of Klikitat River, *Suksdorf*, no. 991, May and June, 1890.

OREGON: Waldo, *Howell*, no. 204, June, 1884.

This species is rather intermediate between *G. cotulaefolia* Steud. and *G. intertexta* Steud. but nearer the latter.

Phacelia lenta

Erect, stout, 2 dm. tall, densely glandular-puberulent throughout and sparsely hirsute: radical leaves oblong in outline, 5–6 cm. long, pinnately parted into about 9 lobes, these coarsely few-toothed, the stout petioles nearly equaling the blade; cauline leaves few, similar, but short-petioled; inflorescence a panicle of rather loose secund false racemes, 8 cm. long, by half as broad, the lateral racemes about 5-flowered; calyx-lobes somewhat unequal, rather broadly oblong or oblanceolate, obtuse, ciliate as well as glandular, 6 mm. long: corolla apparently white, campanulate, cleft to the middle: stamens, pistil and capsule just as in *P. sericea* Gray.

Bare hills of the Columbia River, Wash., *Brandegee*, no. 976, May, 1883.

Very closely related to *P. sericea* Gray, from which its much broader calyx-lobes, looser inflorescence and glandular pubescence seem clearly to distinguish it. The single specimen examined is rather fragmentary.

Lappula arida

Perennial, erect, 3–5 dm. tall, branched above, canescently hirsute throughout, the pubescence mostly appressed: radical leaves linear or narrowly lanceolate, acute, attenuate into a petiole, 8–20 cm. long, 5–8 mm. wide; cauline linear, 4–12 cm. long, 5 mm. wide, sessile by a broad base, all more or less hirsutely ciliate: racemes loosely flowered, 5–10 cm. long: calyx-lobes linear-oblong, very obtuse, 2 mm. long: corolla white, rotate, 10–12 mm. in diameter; the fornices broader than long, not retuse, short pilose: marginal prickles of the nutlets united at base, all glochidiate at apex, one-half as long as the width of the nutlet, usually more or less incurved; the dorsal surface muriculate and with 6–10 centrally placed short glochidiate bristles; inner face minutely hispid or muriculate, the scar central.

This species has quite the aspect of *L. ciliata* Greene, which is abundant on gravelly hillsides near Spokane. The latter species

has larger blue flowers, nearly smooth obcordate formices, and the nutlets smooth on the back.

The following specimens of the new species have been examined all from Washington: Ellensburg, *Piper*, no. 2676, May, 1897 (type); *Whited*, no. 325; *Elmer*, no. 385; Wenatchee, *Whited*, June, 1896; Peshastin, *Sandberg & Leiberg*, no. 595; Junction Crab and Wilson Creek, *Sandberg & Leiberg*, no. 277; Douglas County, *Spillman*, 27 May, 1896; Clemens Mountain, Yakima County, *Henderson*, in 1892; "E. Washington," *Vasey*, no. 419.

Mimulus breviflorus

Annual, the slender stems simple, or more commonly branched from the base, erect, 4–20 cm. high, minutely puberulent throughout, or nearly glabrous above: leaves lanceolate, rarely oblanceolate or ovate, acute, or inconspicuously few-toothed, narrowed at base into a short petiole, or subsessile, usually shorter than the internodes, gradually reduced above, mostly about 1 cm. long: flowers solitary in the axils on slender pedicels which about equal the leaves: calyx narrowly campanulate, somewhat constricted above, 2–3 mm. long in flower, 6–8 mm. in fruit: the short acute triangular teeth nearly equal: corolla pale yellow, tubular, 4–5 mm. long, the lobes short and rounded: stigma scarcely protruding beyond the calyx.

Nearest to *M. Pulsiferae* Gray, which has a much larger corolla, 10–12 mm. long, a style twice as long as the calyx, more conspicuously petioled leaves, and longer and more viscid puberulence. *M. Pulsiferae* ranges from northern California to Klikitat Co., Wash. *Flett, Suksdorf.* The new species seems confined to the Columbia plateau. It has been collected as follows:

WASHINGTON: Pullman, *Piper*, no. 1858, 3 July, 1894 (type); *Piper*, no. 1826, 15 June, 1894; Wawawai, *Elmer*, no. 774; W. Klikitat Co., *Suksdorf*, no. 203, Sept., 1883; *Suksdorf*, no. 485, 2 July, 1885; Ellensburg, *Whited*, no. 652; Waitsburg, *Horner*, no. 592; Blue Mts., *Piper*, no. 2440; Spokane, *Piper*, no. 2640 and 2764.

IDAHO: Juliaetta, *Sandberg, Heller & MacDougal*, no. 347, 8 June, 1892.

OREGON: Hood River, *Henderson*, in 1883; Hood River, *Mrs. Barrett*, in 1884; E. Oregon River, *Cusick*, no. 1195, in 1884.

This seems to be *M. inconspicuus* in part as understood by Greene, Bull. Cal. Acad. Sci. 1: 116. 1885; not however Gray's species.

A new Adiantum from New Mexico

By Lucien Marcus Underwood

In a small collection of ferns made by Professor F. S. Earle, in New Mexico, there is one *Adiantum* that has been confused with *A. capillus-veneris* of Europe. I find fragmentary specimens of the same plant in Wright's New Mexican collections of 1851–52 as represented in the Columbia Herbarium. I have called the fern

Adiantum modestum

Rootstock widely creeping, often 10–12 cm. long, covered with slender narrow pale brown scales; leaf-stalks scattered, slightly scaly at the base, purplish like the rachises; lamina bi–tripinnate, triangular-ovate, 10–12 cm. or more long, by 5–8 cm. or more wide; leaflets 6–8 mm. wide, nearly as long as wide, 2–5-lobed, but mainly 3-lobed, the incisions narrow and very shallow, the margin in sterile leaflets evenly serrate, those bearing sori similarly serrate between the sori; basal angle ranging from 90°–180°, the stalk and basal veins greenish white, or the former slightly tinged with brownish; sori oblong, 2–3 times as long as wide; veins 3–5 times forked, conspicuous; texture firm.

Roswell, New Mexico. "Abundant on rocks and grassy points overhanging the water of North Spring River," 3 August, 1900, *F. S. Earle*, no. 261 (type). New Mexico, *Wright*, no. 2123, 1851–52.

A plant related to *A. capillus-veneris* but differing from it in the smaller, less incised leaflets, their more rounded compact shape, in the fewer narrower sori, in the light-colored stalks to the leaflets, and in general habit.

The European specimens of *A. capillus-veneris* are usually much more laciniate than the American, but in *A. modestum* the leaflets are barely trilobed with very shallow sinuses.

Professor Eaton in his Ferns of the Southwest called attention to the fact that the Southwestern forms of *A. capillus-veneris* were less divided and more rounded than the typical form of the species and may have had in mind Wright's New Mexican plant which was one of the few cited in that work. That character, however, is

not seen in plants collected in Texas by Newberry and by Holden (C), nor in those collected by Hall (Y), nor in those collected in southern California by Stout (Y), and by Thayer (U), nor in those collected by MacDougal in Arizona in 1891 (U), which agree more nearly with the common European forms of *A. capillus-veneris*. Professor Earle has fortunately collected this fern in some quantity.

COLUMBIA UNIVERSITY, 1 Jan. 1900.

A new Sophia

By T. D. A. Cockerell

Sophia andrenarum

Allied to *S. halictorum* and *S. canescens* (*pinnata*), with which it has been confused; greener than *halictorum*, and more erect, with the lateral stems more ascending, not purple at base: flowering stem glabrous, with a very few gland-hairs: flowers yellow, conspicuous, though the color is mostly in the stamens, the petals being like those of *halictorum*, but a little larger and yellower, and as long as the sepals: upper stem-leaves once pinnatifid, with very long linear divisions: green pods about 12 mm. long, on pedicels about 10.5 mm., both pods and pedicels being distinctly longer than in *halictorum*.

From *S. canescens* or *pinnata* it differs by the bushy habit, with lateral stems, and the character of the upper cauline leaves.

Var. **osmiarum** *

Foliage a little coarser, segments of leaves larger, segments of uppermost leaves broader: flowering stems purplish, white-hairy, without gland-hairs (a character of *ochroleuca*): flowers as in *andrenarum*: a coarser plant than *andrenarum*, with the central axis more developed. The ultimate divisions of the lower leaves and broad-spatulate.

Habitat.—Mesilla Park, New Mexico, flowering in March and April, both growing in dry ground, with *S. halictorum*; very abundant this year on the campus of the N. M. Agricultural College. There can be no doubt that this is distinct from *S. halictorum*, which differs constantly in its foliage and its inconspicuous flowers. It has not been thought necessary to repeat in the description the numerous characters common to all species of this immediate group.

The following table separates the species of *Sophia* which I have found commonly in New Mexico. I have not seen *S. Cumingiana*, reported from New Mexico, but it differs from *halictorum* and *andrenarum* by its larger pods, which are pubescent. In our

* Possibly a hybrid with *S. ochroleuca* (?).

plants the pods are strictly glabrous. Professor E. O. Wooton has an apparently new species, allied to *S. ochroleuca*, which he collected at Pescado Spring, N. M.

Seeds in one row in a cell; petals bright yellow; plant tall; living in the mountains (Sapello Cañon, etc.). *incisa* (Engelm.) Greene.

Seed in two rows of cell; petals pale; plant not so tall; living in the Middle Sonoran zones.

Pods and pedicels ascending; flowers whitish; even the uppermost leaves bipinnatifid; pubescence of stems above dense, of white branched hairs, none glandular; living in irrigated fields and bottom lands. *ochroleuca* Wooton.

Pods ascending from strongly divergent pedicels; flowers yellow or yellowish; living in dry ground.

Flowers inconspicuous; plant spreading from the base; upper stems densely glandular-pubescent; uppermost leaves more or less bipinnatifid, but quite different from those of *ochroleuca*. *halictorum* Cockerell.

Flowers conspicuous, yellow; plant much less spreading; upper leaves once pinnatifid, with long linear divisions; pedicels longer.

Upper stems glabrous, with a very few gland-hairs. *andrenarum* Cockerell.

Upper stems white-hairy, the hairs branched. *andrenarum osmiarum* Cockerell.

On March 18, 1900, at Mesilla Park, I saw *Sophia ochroleuca* freely visited by the honey bee (*ligustica* variety) and by *Halictus amicus* Cockerell.

N. M. AGR. EXP. STA.

Thomas A. Williams

Professor Thomas A. Williams, Assistant Chief of the Division of Agrostology, Department of Agriculture, died suddenly of heart failure, Sunday, 23d December, 1900, at his residence at Takoma Park, D. C. The following resolutions were passed by his associates in the Department:

It is with feelings of profound sorrow and regret that we, the employes of the Department of Agriculture, learn that death has removed from among us our beloved companion and coworker, Thomas A. Williams, a classmate and intimate associate of many of our number. His broad knowledge of scientific matters, his keen appreciation of nature, his kind and forbearing disposition has endeared him to all. He was known to his associates as an indefatigable worker and investigator.

RESOLVED, that in the death of Professor Thomas A. Williams, Science and Agriculture have suffered a great loss, and we, his associates, a dear friend, whose self-forgetfulness in his kindly consideration for the feelings of others, and uniform cheerfulness, often under conditions of severe physical suffering, revealed a lovable character of the highest Christian type. The loss to the Division of Agrostology is irreparable. In the performance of his official duties he had proved himself an excellent executive and an organizer of unusual merit and his relations with his associates in office were always such as to command the highest esteem and respect. He never shirked a duty, and however difficult the undertaking the work performed by him was done most creditably. His loss will be felt most keenly by his associates in the Division, and his memory will remain with them as one whose exemplary life and steadfastness of purpose they should strive to emulate.

RESOLVED, further, that we tender to his bereaved family our heartfelt sympathy in their great loss and invoke for them the blessing of the Heavenly Father, who alone can heal the broken heart and give lasting comfort.

RESOLVED, that copies of these resolutions be sent to the family of the deceased and to the various daily and scientific journals.

COMMITTEE ON RESOLUTIONS FOR THE
DEPARTMENT OF AGRICULTURE.

Report of the Committee of the Society of Plant Morphology and Physiology on Securing better Reviews of Botanical Literature

A committee consisting of W. G. Farlow, D. T. MacDougal, and H. von Schrenk was appointed at the meeting of the Society at New Haven, Dec. 28, 1899, to consider and report upon the best method of securing more adequate notice of American botanical literature. The committee was instructed to open negotiations with the editors of the *Botanische Centralblatt*, and ascertain if it would be possible to have certain changes made in the method of publishing that journal which would meet the views of the Society. The committee followed instructions and was able to report substantial progress at a special meeting of the Society in New York, June 27, 1900. In accordance with further instructions given the Committee, negotiations were continued with the result that the following letter was received by Dr. Ganong, acting as Secretary of the Committee, on Nov. 28th.

CASSEL, 14–11, 1900.

Sehr verehrter Herr Professor!

Längeres Unwohlsein sowie eine plötzlich nothwendig gewordene Reise nach Berlin tragen die Schuld, dass ich erst heute die so liebenswürdige und für das Centralblatt schmeichelhafte Zuschrift Ihres Comittees beantworten kann.

Nach reiflicher Prüfung Ihrer Vorschläge, gegen deren Richtigkeit wir von Anfang an nichts einzuwenden hatten, sind wir zu dem Entschlusse gekommen, vom 1 Januar 1901 an in dem Hauptblatte des Botanisch. Centralblattes, welches in bisheriger Stärke und zu demselben Preise wie bisher erscheinen soll und natürlich für sich abonnirt werden kann, nur noch Referate und die Neue Litteratur zu bringen. Die Beihefte aber, welche in zwanglosen Heften erscheinen und ebenfalls für sich allein bezogen werden sollen, würden dann nur noch die Originalarbeiten bringen. Auf die pecuniäre Untersützung seitens der Herren Amerikaner, um die wir übrigens nur gebeten hatten, weil wir aus Ihrer ersten Zuschrift geschlossen hatten, dass Sie beträchtliche Erhöhung des Umfanges des Centralblattes wünschten, verzichten wir natürlich

unter den obwaltenden Umständen gern, würden aber sehr zu Danke verpflichtet sein, wenn Ihr Comittee und namentlich die beiden Herren, welche Sie aus Ihrer Mitte zu Mitherausgebern erwählen wollen, uns Ihre Unterstützung durch rege Mitarbeit zu theil werden lassen wollten und das C. Bl. in Amerika etc. weiter empfehlen würden.

Ich denke mir die Thätigkeit der Herren Mitherausgeber, deren Namen natürlich mit auf dem Titel des C. Bl. geführt werden würden, in der Weise, dass die Herren selber viele Referate anmelden, resp. andere Herren zur Anmeldung solcher Berichte bei ihnen veranlassen. Eine Liste der so mit Beschlag belegten Arbeiten und Bücher senden Sie mir dann immer möglichst umgehend zu, damit nicht Doubletten einlaûfen. Die Herren Mitherausgeber erhalten für die für sie entstehende Mehrarbeit für die von ihnen gelieferten Referate ein Vorzugshonorar von 75M, die anderen Referenten aber wie bisher 45M. für den Druckbogen.

Vor allen Dingen liegt mir natürlich daran, in Zukunft die neue amerikan. Litteratur so schnell und vollständig wie möglich unseren Lesern bieten zu können. Gerade hierfur aber muss ich um die Unterstützung Ihrerseits bitten, die Sie mir dadurch bethätigen könnten, dass Sie die amerikanischen Autoren, Institute, Gesellschaften und Zeitschriften veranlassen, mir von allen neu erscheinenden Schriften etc. so schnell wie möglich ein Exemplar zur Aufuahme in die Neue Litteratur zu schicken. Nur geschriebene Titel führen, wie ich aus langjähriger Erfahrung als Bibliothekar und Redacteur weiss, nur zu unangenehmen Irrthümern und Verwechselungen.

Hoffentlich führt die Vereinigung der amerikan. und europäischen Botaniker zu einem wirklichen Fortschritte des C. Bl. An mir soll es nicht fehlen! Ich werde Alles aufbieten, um die gemeinsame Arbeit zu einer recht segensreichen zu gestalten. Hoffentlich gelingt es mir, in den anderen Ländern ähnliche Einrichtungen wie in Amerika zu treffen.

In der Hoffnung, dass Sie selber eine der Mitherausgeberstellen annehmen werden und Ihnen nochmals für das bewiesene Interesse dankend

hochachtungsvollst ergebenst.

Ihr

DR. UHLWORM.

The following paragraphs quoted from the text of the report summarize the changes which the editors of the *Centralblatt* propose to carry into effect:

"The changes, as will be seen from Dr. Uhlworm's letter, are in conformity with the suggestions made by the committee in its report and will meet with the approval of all American botanists. *It is proposed to include in the Centralblatt proper only reviews and the index of literature; the Beihefte will contain only original articles; the Centralblatt may be subscribed for without also subscribing for the Beihefte;* and, lastly, the price of the *Centralblatt* is to remain as at present. On these points, therefore, the letter of Dr. Uhlworm is entirely satisfactory.

"The suggestion that American editors be nominated by a representative body of American botanists seems to be excellent and likely to prove helpful to the *Centralblatt* by stimulating our botanists to make a determined and combined effort to do all in their power to enable the editors of the *Centralblatt*, so far, at least, as American botanical literature is concerned, to make their journal indispensable to all botanists. Hereafter it will be a matter of pride to us to show that our interest is not merely passive, but that we are ready to make active individual and collective effort to secure a desirable result.

"The committee feels that in offering the following recommendations to the Society, its work is brought to an end and that it may ask to be discharged from further service. There are other subjects mentioned in Dr. Uhlworm's letter which the Society will probably wish to discuss at their meeting, but they are matters of detail which it seems to us had better be referred, so far as any action is needed, to a special committee.

"It is recommended:

"First, that the secretary be directed to write to Dr. Uhlworm and express our hearty approval of the changes proposed and our readiness to coöperate.

"Secondly, that a committee of three be appointed by the Society with full power to represent the Society in further negotiations with the management of the *Centralblatt* up to such time as the selection of American editors shall have been definitely

made, the committee to report to the Society at its next annual meeting.

"Thirdly, that the committee thus appointed be requested to invite one botanist from the Central States and one botanist resident on the Pacific Coast to serve with them in the selection of American editors and in such preliminary business as may be necessary for the furtherance of the plans proposed by the editors of the *Centralblatt.*

"Fourthly, that a copy of this report, or of such parts of it as may seem desirable in order to call the attention of our botanists to the changes to be made in the *Centralblatt*, be sent to the *Botanical Gazette*, the *Bulletin of the Torrey Club* and to *Science.*"

The report of the committee was accepted and its action approved unanimously in all particulars. The new committee appointed consists of W. G. Farlow, D. T. MacDougal, and W. F. Ganong in place of H. von Schrenk, who resigned after reappointment. The action of the committee in selecting editors and arranging details of coöperation will complete the most important step yet made toward proper bibliographical treatment of American botanical literature.

Index to recent Literature relating to American Botany

Andrews, A. L. Ferns of a deep Ravine in Thetford, Vermont. Rhodora, **2**: 229, 230. D. 1900.

Atkinson, G. F. Studies of American Fungi.—Mushrooms, edible, poisonous, etc. 8vo. i–vi, 1–275. *pl. 1–76. f. 1–222.* Ithaca, N. Y., 20 O. 1900.

New species in *Hypholoma*, *Amanita* (3), *Lepiota*, *Mycena*, *Bolbitius*, *Paxillus*, and *Hydnum*.

Brainerd, E., Jones, L. R. & Eggleston, W. W. Flora of Vermont. A list of the Fern and Seed Plants growing without Cultivation. i–xii, 1–113. Burlington. 15 D. 1900.

Includes *Agropyron Novae-Angliae* Scribner, sp. nov., *Prenanthes altissima hispidula* Fernald, var. nov., and a new hybrid, *Carex stricta* × *torta* Fernald.

Briquet, J. Espèces nouvelles ou peu connues de l'Herbier Delessert. Ann. Conserv. & Jard. Bot. de Genève, **4**: 213–243. 1900.

Includes new species in *Seguieria*, *Xylosma* (2), *Banara*, *Phyllanthus*, *Hieronymia*, *Croton* (2), *Acalypha*, *Jatropha* (2), *Sebastiania*, *Dalechampia*, *Cyrilla*, *Verbena-Lippia* (5,) *Scutellaria*, and *Hyptis* from Mexico and South America.

Briquet, J. Labiatae et Verbenaceae Wilczekianae, ou Énumération des Labiées et des Vérbénacées récoltées par E. Wilczec en janvier et février 1897 dans la République Argentine. Ann. Conserv. & Jard. Bot. de Genève, **4**: 14–22. 1900.

Includes five new species of *Verbena*.

Brown, N. E. *Acicarpha rosulata* N. E. Brown, sp. nov. Hook. Ic. Plant. IV. **7**: *pl. 2636. f. 5–11.* May, 1900.

Native of southern Patagonia.

Brown, N. E. *Benthamiella Nordenskioldii* Dusen, sp. nov. Hook. Ic. Plant. IV. **7**: *pl. 2636. f. 1–4.* May, 1900.

Native of southern Patagonia.

Cheney, L. S. An historical Review of the Work done on the Flora of the Territory now included within the Limits of Wisconsin. Pharmaceutical Review, **18**: 557–565. D. 1900; **19**: 2–15. Ja. 1901.

Cogniaux, A. *Laelio-Cattleya Binoti* hyb. nat. nov. Gard. Chron. III. **28**: 370. 24 N. 1900.

Native of Brazil.

Collins, G. N. An ornamental Species of *Bidens*. Plant World, **3**: 161–163. *pl. 6, 7*. N. 1900.
Bidens heterophylla.

Coulter, J. M. & Rose, J. N. Monograph of the North American Umbelliferae. Contr. U. S. Nat. Herb. **7**: 1–256, i–vii. *pl. 1–9. f. 1–65*. 31 D. 1900.
New species in *Hydrocotyle, Bowlesia, Sanicula, Eryngium* (5), *Chaerophyllum, Washingtonia* (4), *Drudeophytum* n. g., *Ammoselinum, Cicuta, Aletes* (4), *Ligusticum* (7), *Coelopleurum, Oreoxis, Phellopterus, Pteryxia, Aulospermum* n. g. (2), *Rhysopterus* n. g. (2), *Pseudocymopterus, Oxypolis, Leptotaenia* (2), *Lomatium* (7), *Euryptera, Cynomarathrum* (2).

Coulter, S. Some unrecognized Forms of native Trees. Proc. Indiana Acad. Sci. 1899: 112–116. 1900.

Coulter, S. Contributions to the Flora of Indiana. VI. Proc. Indiana Acad. Sci. 1899: 104–112. 1900.

Dorner, H. B. The resin Ducts and strengthening Cells of *Abies* and *Picea*. Proc. Indiana Acad. Sci. 1899: 116–129. 1900. [Illust.]

Driggs, A. W. Notes on the Flora of Connecticut. Hartford, Litchfield and Tolland counties. 4 pp. Hartford. 1 Ja. 1901.

Eaton, A. A. The genus *Isoetes* in New England. Fernwort Papers, 1–16. 20 D. 1900.
I. heterospora, I. hierogl phica, I. Harveyi, and *I. Gravesii* sp. nov.

Ellis, J. B. & Everhart, B. M. The North American Phyllostictas with Descriptions of the Species published up to August, 1900. 1–79. Vineland, N. J. D. 1900.
Includes *P. erratica, P. Fraserae, P. minor, P. decipiens, P. acanthospermi, P. consimilis, P. nymphaeacea, P. pallens*, and *P. fusispora*, new species.

Fernald, M. L. The Representatives of *Scirpus maritimus* in America. Rhodora, **2**: 239–241. D. 1900.
S. robustus paludosus and *S. robustus campestris*, new combinations.

Fernald, M. L. Two northeastern Thalictrums. Rhodora, **2**: 230–233. *pl. 21*. D. 1900.
Thalictrum confine sp. nov.

Gilbert, B. D. *Athyrium* as a genus. Fernwort Papers, 25–29. 20 D. 1900.

Golden, K. E. *Saccharomyces anomalus* Hansen (?). Proc. Indiana Acad. Sci. 1899: 141–144. 1900. [Illust.]

Golden, K. E. A proteolytic Enzyme of Yeast. Proc. Indiana Acad. Sci. 1899: 129–140. 1900. [Illust.]

Gould, C. N. Jack Oaks in Oklahoma. Plant World, 3 : 165–167. N. 1900.

Graves, C. B. Some Observations upon the early Growth of *Impatiens biflora*. Rhodora, 2 : 234, 235. D. 1900.

Greene, E. L. A Fascicle of new Arnicas. Pittonia, 4 : 159–174. 8 D. 1900.

Twenty-four new species proposed.

Greene, E. L. A Decade of new Gentianaceae. Pittonia, 4 : 180–186. 8 D. 1900.

New species in *Gentiana*, *Swertia*, and *Frasera*.

Greene, E. L. Studies in the Cruciferae.—III. Pittonia, 4 : 187–207. 8 D. 1900.

New species in *Arabis* (17), *Cheiranthus*, *Sophia*, *Thelypodium*, *Thysanocarpus*, and *Cardamine* (4). A new genus *Abdra* proposed, founded on *Draba brachycarpa* Nutt.

Greene, E. L. Neglected generic Types.—II. Pittonia, 4 : 207–212. 8 D. 1900.

Halerpestes, *Peritoma*, *Celome*, *Carsonia*, and *Aldenella*, new genera.

Greene, E. L. Some Rocky Mountain Asters. Pittonia, 4 : 212–224. 8 D. 1900.

Eighteen new species proposed.

Greene, E. L. Corrections in Nomenclature.—III. Pittonia, 4 : 224–226. 8 D. 1900.

Greene, E. L. A Fascicle of Senecios. Pittonia, 4 : 108–110. 2 Ja. 1900 ; 111–124. 10 Ja. 1900.

Sixteen new species and several new names and combinations proposed.

Greene, E. L. New species of *Coleosanthus*. Pittonia, 4 : 124–126. 10 Ja. 1900.

Four new species proposed.

Greene, E. L. A Decade of new Pomaceae. Pittonia, 4 : 127–131. 2 Mr. 1900.

New species in *Amelanchier* (5) and *Sorbus* (5).

Greene, E. L. A Fascicle of new Papilionaceae. Pittonia, 4 : 132–139. 2 Mr. 1900.

New species in *Lupinus* (9), *Trifolium* (3), *Hedysarum* and *Thermopsis*.

Greene, E. L. Notes on Violets. Pittonia, 4 : 139–142. *pl. 12*. 2 Mr. 1900.

Viola Missouriensis, sp. nov.

Greene, E. L. Some new or critical Ranunculi. Pittonia, 4 : 142–146. 2 Mr. 1900.

Four species and two varieties proposed as new.

Greene, E. L. New or Noteworthy Species.—XXVII. Pittonia, **4**: 146–158. 2 Mr. 1900.

New species in *Cyrtorhyncha*, *Clematis*, *Geum*, *Androsace* (5), *Physalis*, *Castilleia*, *Verbena* (2), *Chrysothamnus*, *Chrysopsis* (3), *Grindelia*, *Erigeron* (3), *Eucephalus*, *Townsendia*, *Machaeranthera* and *Alisma*.

Halsted, B. D. American and English Weeds compared. Plant World, **3**: 171–173. N. 1900.

Hemsley, W. B. *Zschokkea utilis* Hemsl. nom. nov. Hook. Ic. Plant. IV. **7**: *pl. 2637*. My. 1900.

Native of British Guiana.

Hemsley, W. B. *Eryngium Goldmani* Hemsl. sp. nov. Hook. Ic. Plant. IV. **7**: *pl. 2638*. My. 1900.

Native of northern Mexico (Chihuahua).

Hemsley, W. B. *Sapium verum* Hemsl. sp. nov. Hook. Ic. Plant. IV. **7**: *pl. 2647*. My. 1900.

Native of Colombia.

Hemsley, W. B. *Sapium? paucinervium* Hemsl. sp. nov. Hook. Ic. Plant. IV. **7**: *pl. 2648*. My. 1900.

Native of British Guiana.

Hemsley, W. B. *Sapium Jenmani* Hemsl. sp. nov. Hook. Ic. Plant. IV. **7**: *pl. 2649*. My. 1900.

Native of British Guiana.

Hemsley, W. B. *Sapium aucuparium* Jacq. Hook. Ic. Plant. IV. **7**: *pl. 2650*. My. 1900.

Native of British Guiana.

Hemsley, W. B. *Moquilea platypus* Hemsl. Hook. Ic. Plant. IV. **7**: *pl. 2618, 2619*. Je. 1899.

Native of Central America.

Hemsley, W. B. *Couepia dodecandra* Hemsl. nom. nov. Hook. Ic. Plant. IV. **7**: *pl. 2620, 2621*. Je. 1899.

From Mexico and British Honduras.

Hervey, E. W. Yellow-fruited *Ilex verticillata*. Rhodora, **2**: 242. D. 1900.

Hochreutiner, B. P. G. Revision du genre Hibiscus. Ann. Conserv. & Jard. Bot. de Genève, **4**: 23–191. 1900.

Includes *H. pseudo-ferox* sp. nov. from U. S. of Colombia.

Jones, L. R. & Orton, W. A. Report of the Botanists. Rep. Vt. Exper. Sta. **12**: 151–188. 1900.

Discusses diseases of potatoes and apples and second list of Vermont parasitic fungi. Pp. 165–182; also issued as contributions to the Botany of Vermont, VII.

Kränzlin, F. *Stanhopea stenochila* Lehm. & Krzl., sp. nov. Gard. Chron. III. **28**: 369, 370. 24 N. 1900.
Native of Colombia.

Lagerheim, G. Mykologische Studien. II. Untersuchungen über die Monoblepharideen. Bihang Svenska Vet.-Akad. Handl. **25**[8]: 1–42. *pl. 1, 2.* 1899.

Leavitt, R. G. Polyembryony in *Spiranthes cernua.* Rhodora, **2**: 227, 228. D. 1900.

Lindman, C. A. M. Vegetationen i Rio Grande do Sul. 1–239. *f. 1–64.* Stockholm. 1900.

Malme, G. O. A:N. Ex Herbario Regnelliano, Adjumenta ad floram phanerogamicam Brasiliae terrarumque adjacentium cognoscendam. III. Leguminosae Vochysiaceae, etc. Bihang Svenska Vet.-Akad. Handl. **25**[11]: 1–60. *pl. 1, 2.* 1900.
New species in *Dalbergia, Drepanocarpus, Cenostigma, Bauhinia, Mimosa* (2), *Pithecolobium.*

Malme, G. O. A:N. Beiträge zur Stictaceen-Flora Feurlands und Patagoniens. Bihang Svenska Vet.-Akad. Handl. **25**[5]: 1–36. *pl. 1, 2.* 1899.

Malme, G. O. A:N. Brasilianska Akarodomatieförnde Rubiaceer. Bihang Svenska Vet.-Akad. Handl. **25**[9]: 1–21. 1900.

Maxon, W. R. Notes on American Ferns.—III. Fern Bull. **8**: 84, 85. O. 1900.

Maxon, W. R. On the occurrence of the Hart's Tongue in America. Fernwort Papers, 30–46. 20 D. 1900.

Moore, T. V. Some *Rudbeckia* Segregates. Pittonia, **4**: 174–180. 8 D. 1900.
Seven species and one variety proposed as new.

Pollard, C. L. A new *Helianthus* from Florida. Proc. Biol. Soc. Washington, **13**: 184. 30 N. 1900.
H. agrestis.

Rehm, H. *Ascomyces Fuegiani* A. P. Dusén Collecti. Bihang Svenska Vet.-Akad. Handl. **25**[6]: 1–22. *pl. 1.* 1899.
Includes numerous new species.

Robinson, B. L. *Polygala polygama* var. *abortiva,* merely an autumnal State. Rhodora, **2**: 242, 243. D. 1900.

Robinson, B. L. The Nomenclature of the New England Agrimonies. Rhodora, **2**: 235–238. D. 1900.
Four changes in the names of the five New England species.

Rolfe, R. A. *Catasetum labiatum* Rodr. Hook. Ic. Plant. IV. **7**: *pl. 2617*. Je. 1899.

Native of Brazil.

Scribner, F. L. & Merrill, E. D. Agrostological Notes. Circ. U. S. Dept. Agric. (Div. Agrost.) 27: 1–10. 4 D. 1900.

Review of grasses in Muhlenberg's herbarium; new species and names in *Eatonia Panicum, Agropyron, Elymus, Melica*, and *Stipa*.

Slosson, M. Experiments in Hybridizing Ferns. Fernwort Papers, 19–25. 20 D. 1900.

Starbäck, K. Ascomyceten der ersten regnellschen Expedition.—I. Bihang Svenska Vet.-Akad. Handl. **25**[1]: 1–68. *pl. 1, 2*. 1899.

Many new species; *Nostocotheca, Ophiomeliola, Ijuhya, Malmeomyces* and *Actiniopsis*, new genera; and Myriangiales a new order.

Suksdorf, W. N. Washingtonische Pflanzen. Deutsche Bot. Monatsschrift, 18: 97–99. Jl. 1900; 132–134. S. 1900; 153–156. O. 1900.

New species and varieties in *Viburnum, Valerianella, Artemisia, Troximon, Dodecatheon, Phlox, Gilia, Nemophila, Amsinckia, Pentstemon, Mimulus, Castilleia*.

Thomas, M. B. Some Problems in *Corallorrhiza*. Proc. Indiana Acad. Sci. 1899: 145. 1900.

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Webster, H. *Tricholoma portentosum*. Rhodora, **2**: 243–246. D. 1900.

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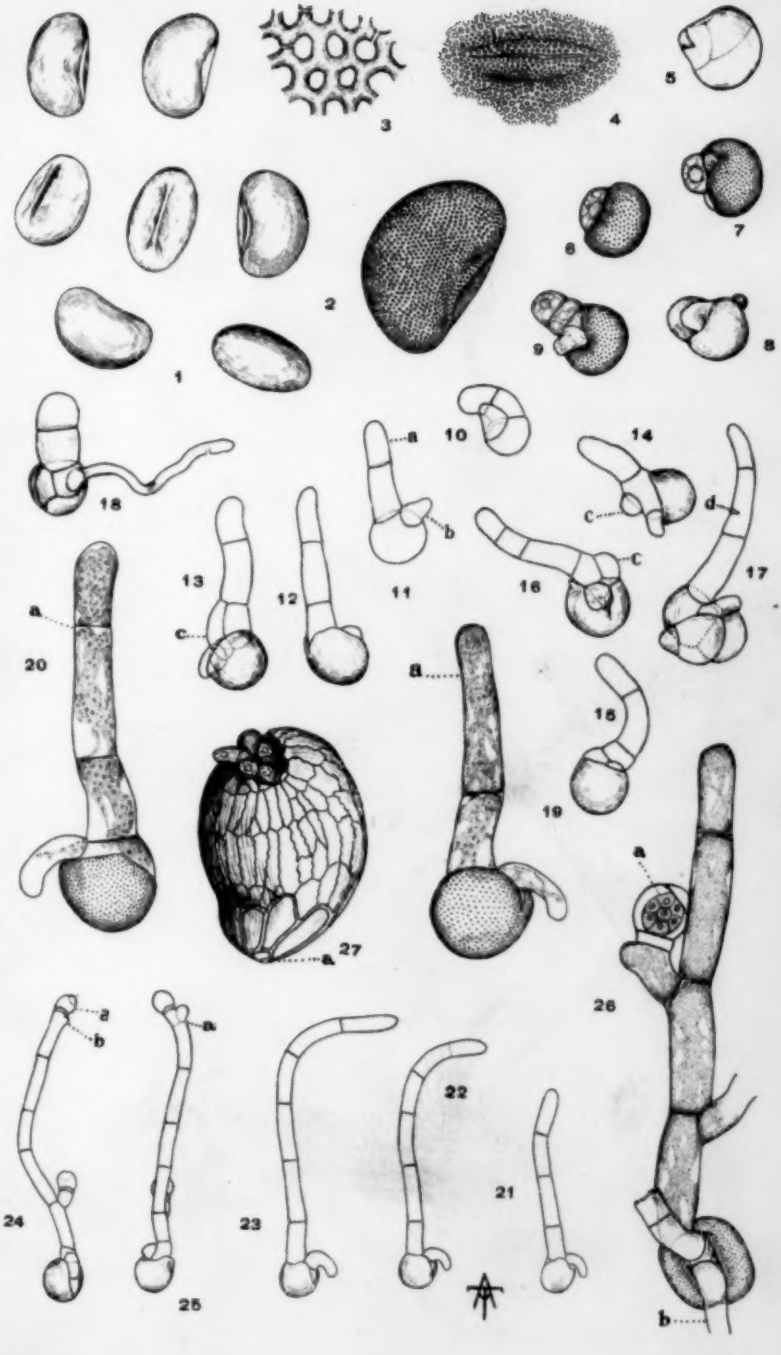
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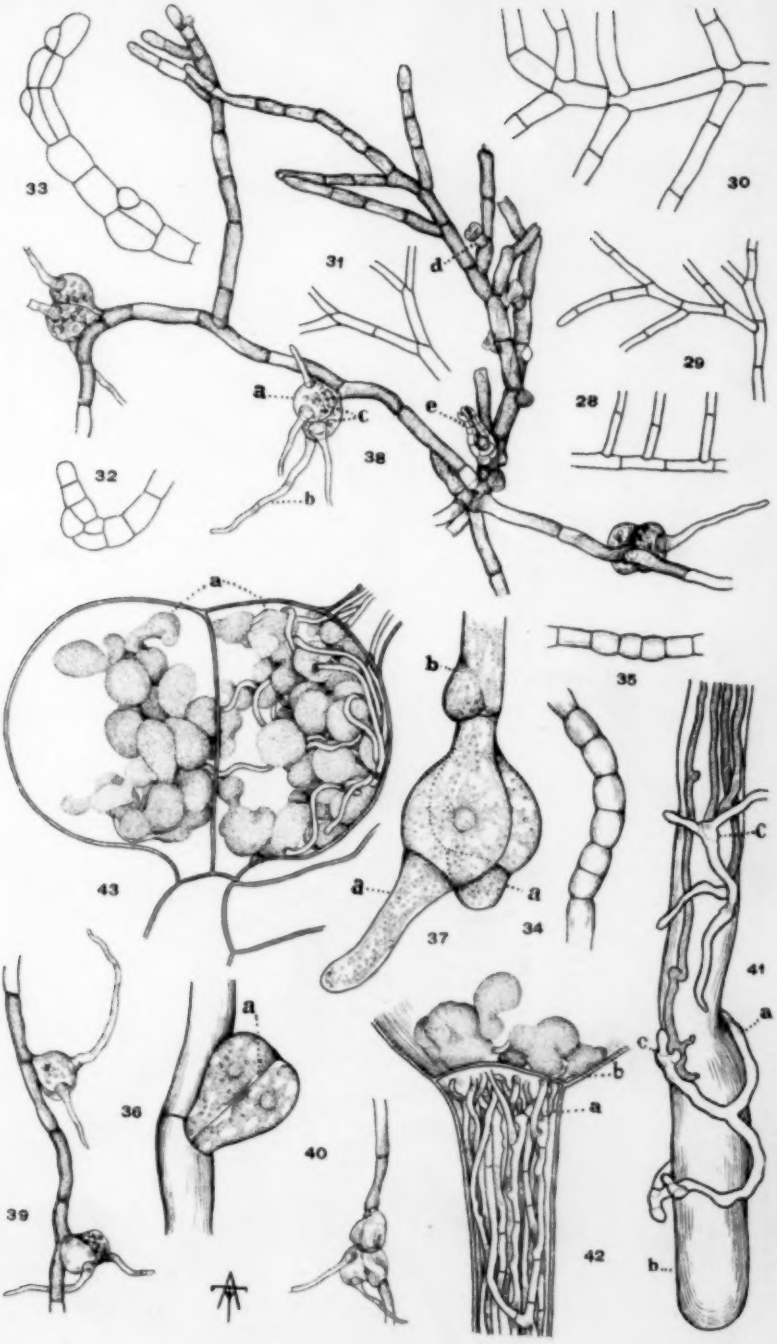

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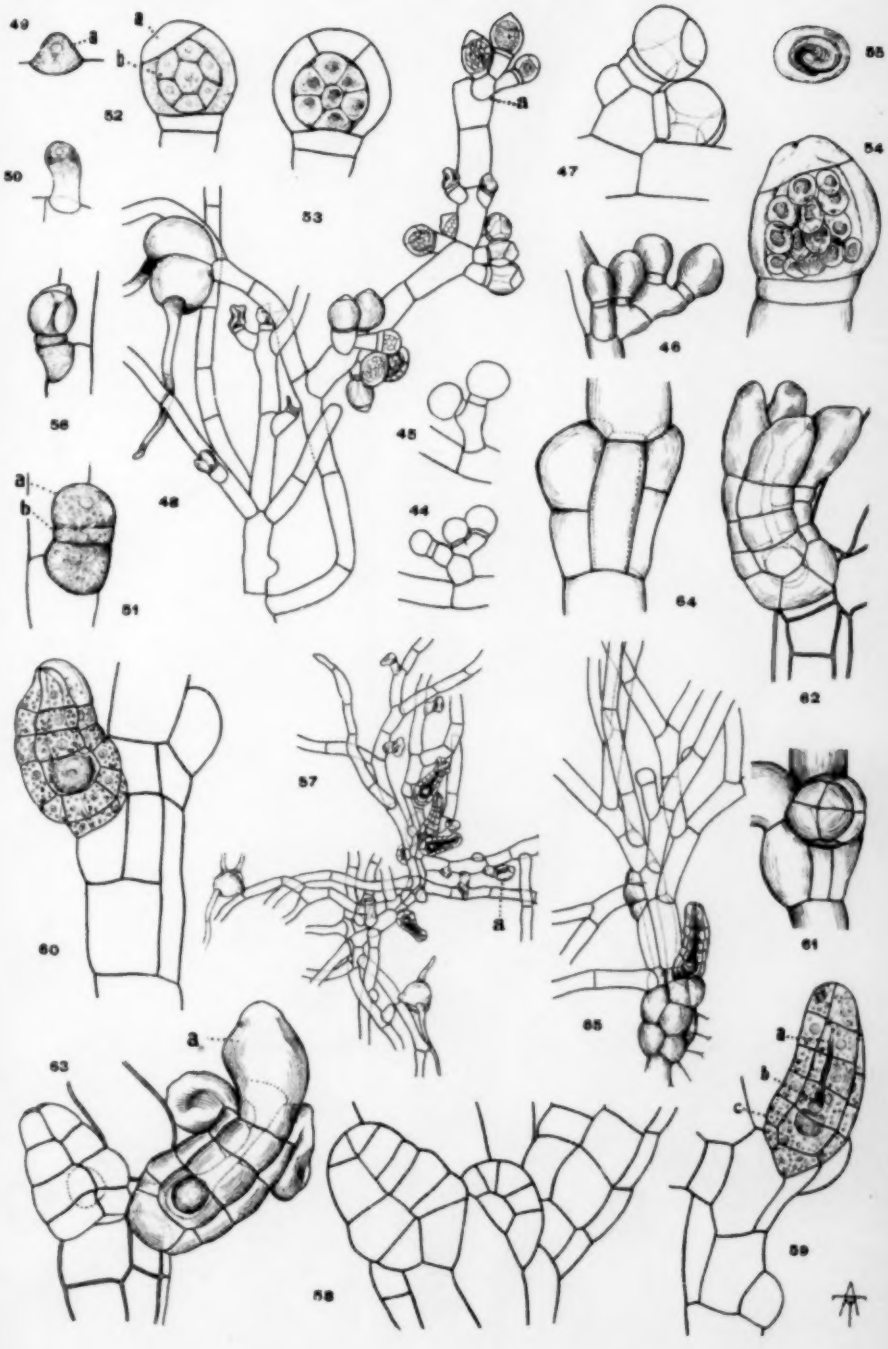

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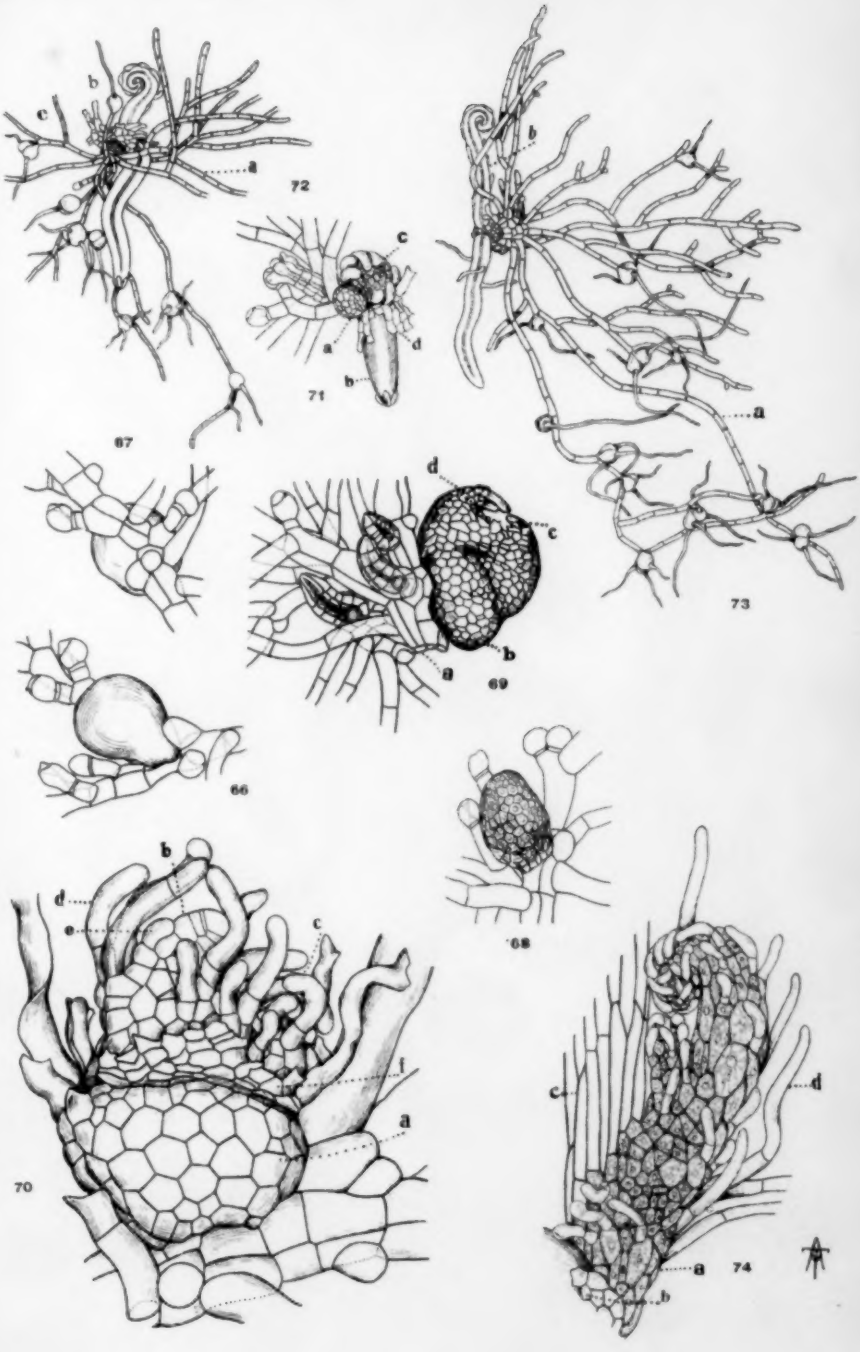

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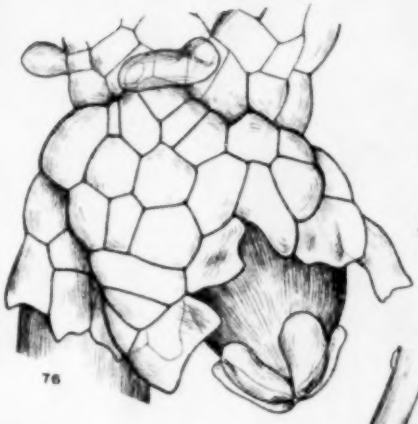
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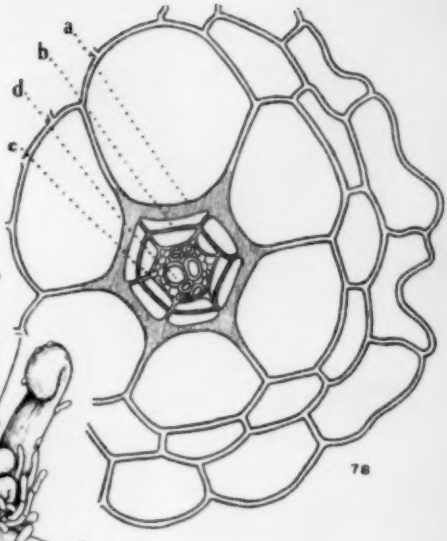

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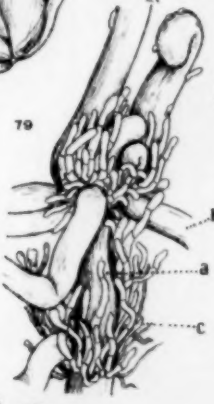

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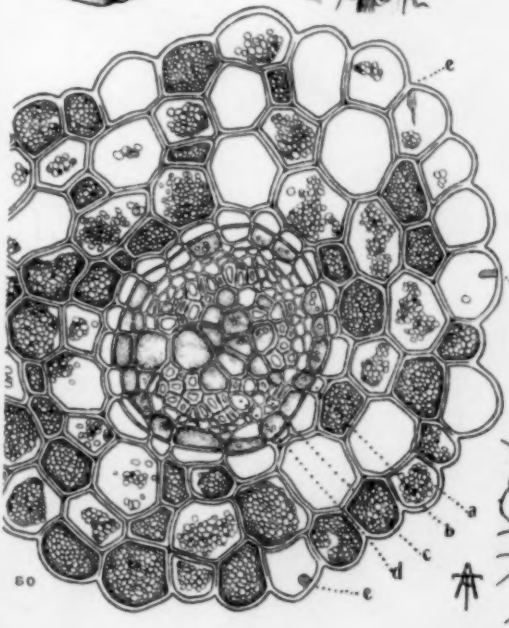

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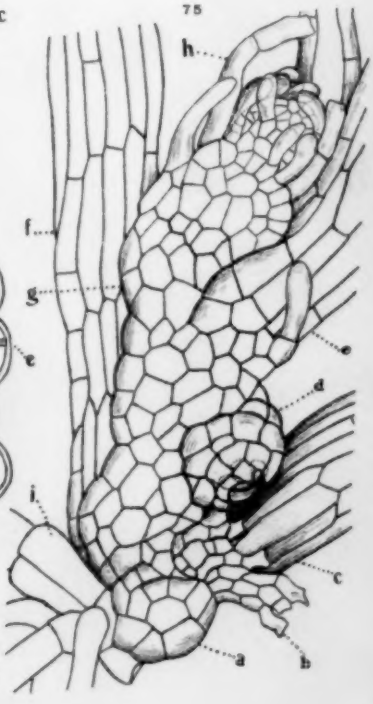

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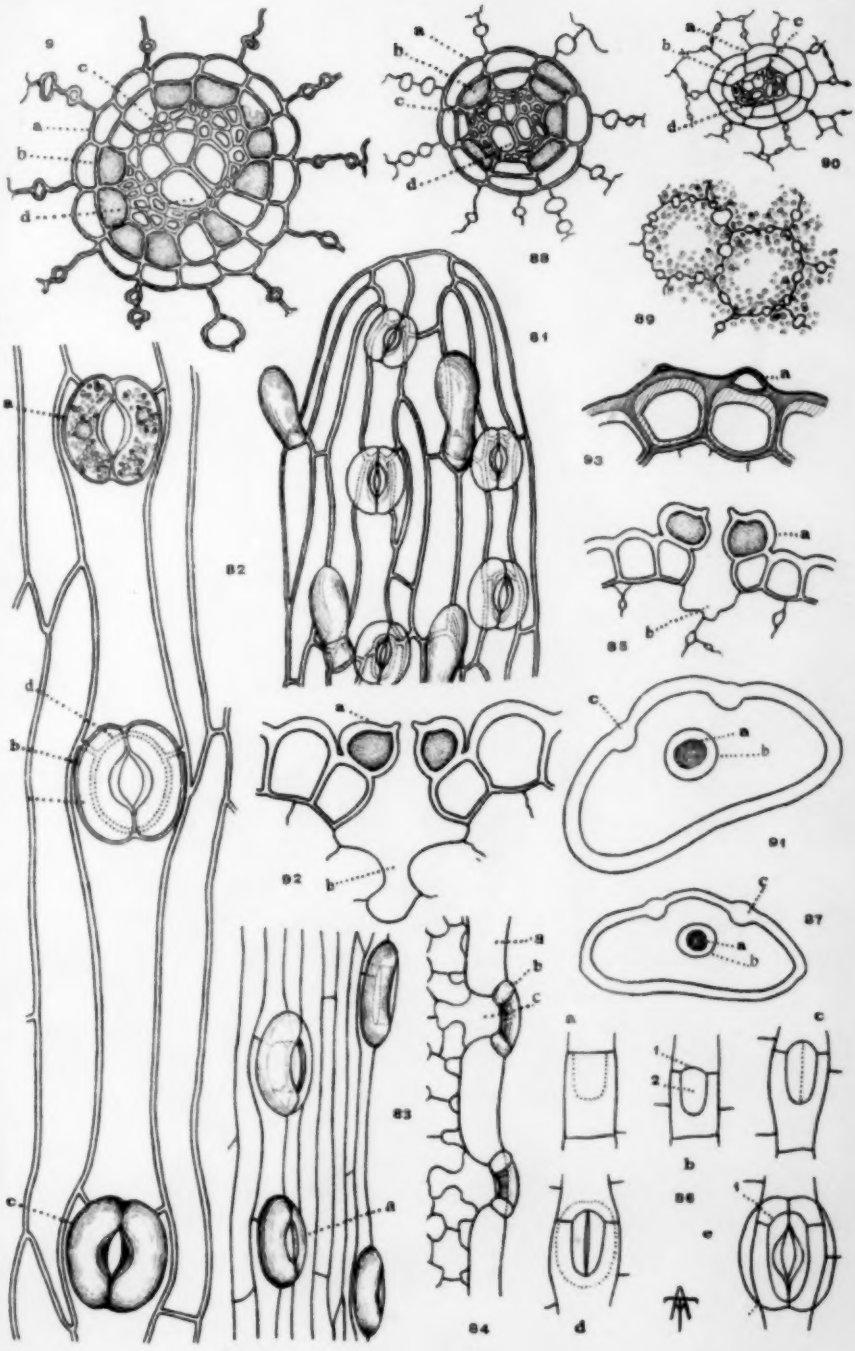
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